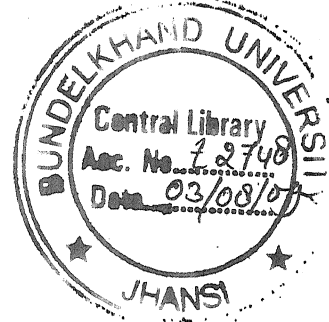


**STUDY OF DIGENETIC PARASITES OF FISHES OF
BUNDELKHAND REGION**

**THESIS
SUBMITTED FOR THE DEGREE
OF
DOCTOR OF PHILOSOPHY
IN
ZOOLOGY
TO**



**BUNDELKHAND UNIVERSITY
JHANSI - 284128 (U.P.)
2004**

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**UNDER THE SUPERVISION OF
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पूज्य माताजी एवं पिताजी
को
समर्पित

CERTIFICATE

It is certified that the work presented in the thesis entitled "*Study of digenetic parasites of fishes of Bundelkhand region*" has been carried out under my supervision by Mr. Rajeev Kumar Singh, for the fulfillment of the requirement for the degree of Doctor of Philosophy in Zoology to Bundelkhand University, Jhansi.

I further certify that work and the approach adopted by the investigator is entirely original and it has neither been carried out anywhere else in the same form and manner nor it has been submitted for any other degree of this or any other university.

Mr. Rajeev Kumar Singh has put in more than 200 days of working in the Department from the date of his registration for his Ph.D. work of University, as required under the relevant ordinance.



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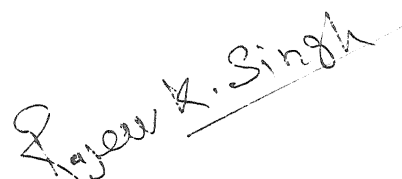
I would like to take this opportunity to express my extreme gratitude to my supervisor Dr. L.N. Agarwal for his valuable suggestions, guidance and moral inspiration during the research work. This work cannot be even imagined with out his sincere help and encouragement.

I am grateful to Dr. Kusum Singh, Lecturer, department of Zoology, B.U.Jhansi for making useful suggestions in carrying out this research work and compilation of thesis. I am also thankful to Dr. Gazala Rizvi, Mohd. Iqbal Khan, Mr. Surendra Kumar Verma for their constructive support to materialize this work.

I could not find appropriate words to express my gratitude to my parents for their love, affection and continuous moral support. I also thank my brothers, sisters, wife and children for their kind cooperation.

I also acknowledge all my relatives and friends for their encouragement.

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(Rajeev Kumar Singh)

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INTRODUCTION

Helminths play a significant role in the day-to-day economy of man and his domestic animals. The trematodes, occurring as active adults in vertebrates, comprise two broad divisions based on their life histories the monogenetic and the digenetic. The digenetic trematodes being more important group found practically in every part of body of the host, whether cold or warm-blooded and require one or more intermediate hosts for completing their life cycle. The monogenetic trematodes are ectoparasitic and their entire life cycle is completed in a single host. India is well known for abundance of helminth parasites. Quite a large number of species of trematodes parasitising fishes, amphibians, reptiles, birds and mammals including man have been reported from India. Some of them are highly pathogenic and cause diseases. They infect different organs of the host and the damage caused by their infection depends very much on the intensity of infection and the type of organ involved.

Being important link in the food chain as primary and secondary consumers, fishes constitute a useable proteinous source of diet. Such an important source of food is continuously depleting due to the parasitic load on them and thus making their use unfit for human consumption. An acute infection of trematodes is found to be one of the causes of the mass mortality of fishes. To overcome the immense loss of such a vulnerable food resource, a multifaceted approach is required.

The digenetic trematodes exhibit great diversity in their morphology, habit and habitat. The classification of a large number of species is still unsettled. However, the variety as well as the diversity

makes the group of increased interest in studies of host relationship, speciation and phylogeny (Manter, 1957). Though a large number of digenetic trematodes are known from fishes but our knowledge is still incomplete even in regard to the adult trematodes and more inadequate in regard to their life cycles and larval stages. Wherever, extensive surveys have been made, it is seen that the number of species of digenetic trematodes approaches the number of species of fishes examined (Manter, 1957). A number of Indian workers from time to time have worked out the trematode fauna of fishes of various regions of the country. However, to the best of our knowledge so far, no appreciable work has been done on the digenetic trematode parasites of fishes of Bundelkhand region, specially in bordering districts of Uttar Pradesh.

Bundelkhand region of the Indian continent is peculiar and unique in its topography (Fig. 1), having vast stony area and numerous water resources including the ancient as well as historical water reservoirs. Agrawal (1980) made an attempt to survey the trematode fauna of fishes of some of the districts of Bundelkhand region of Uttar Pradesh viz. Banda, Hamirpur, Jalaun, Jhansi and Lalitpur, but some districts of Bundelkhand region, are still unexplored from this point of view. The important water resources of Bundelkhand region comprise the rivers like, Betwa, Dhasan, Ken, Urmil and Yamuna; reservoirs like – Arjun dam, Devendra Sagar dam, Matatila dam, Maudaha dam, Rajghat dam and lakes like- Barwasagar, Belatal, Benisagar, Jagatsagar, Kiratsagar, Kulpahar tank, Niwarital and Rath tal etc.

Extensive surveys for the helminth parasitic load of the fishes from these water resources have been conducted from March 2002 to December 2004. Fishes available at fish markets of the different localities of the Bundelkhand region were also examined for the helminth infection. In the present thesis only the account of the digenetic trematodes of fishes is given.

The Bundelkhand extends from ($24^{\circ} - 26^{\circ}$ N and $78^{\circ} 10' - 81^{\circ} 30' E$), bounded by Yamuna in the north, escarpment ranges of Vindhyan plateau in the south, and the Chambal river in the south-east, (Singh, 1971). It comprises of five districts Banda, Hamirpur, Jalaun, Jhansi and Lalitpur of Uttar Pradesh. The key note of Bundelkhand topography is its smooth and undulating character to which Spate and Leach (1954) give the term senile topography. The entire region is marked by subdued topography. The peculiar features of immense geomorphic interest in this region are the long, narrow, serrated edges termed as Quartz reefs and dolerite dykes. The former are very conservative in their direction and persist at long distances like fort walls, and they have frequently intercepted the courses of regional streams, thereby providing suitable sites for a large number of water bodies and semiartificial tanks, giving enough security to agriculture and pisciculture. By and large, Bundelkhand is a distinct geographical region of India. It has further divisions on the basis of their physical, social and economic distinctiveness (Siddiqui, 1966). The major divisions are:

A. Bundelkhand plain

- (i) Revine belt
- (ii) Jalaun plain
- (iii) Hamirpur plain
- (iv) Banda plain west and east

B. Bundelkhand upland

- (i) Bundelkhand Gneissic Region
- (ii) Bundelkhand Vindhyan Plateau
(Consisting of Banda, Chitrakoot plateau)

Centrality of the region imposes on it the features of a transitional climate between the maritime climate of the east coast (Bay of Bengal) and the tropical continental dry type climate of the west Rajasthan (Singh, 1971). It experiences excessive heat during summers (March – June) and mild cold during the winters (November – February). Bundelkhand region often registers the largest number of sunstrokes every year owing probably to intense terrestrial radiation and lack of haziness in the sky.

The mean atmospheric temperature in the summers varied from 25.95°C – 34.65°C (March- June) but actual temperature was much higher and mercury often recorded 42.4°C during may when the heat became oppressive accompanied by the scorchin winds. Relative humidity varied from 16.6% - 67.0%.

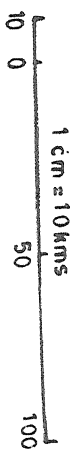
It is seen that with the advent of monsoons by the middle of June, the temperature falls abruptly, giving a sense of general relief. The mean atmospheric temperature duiring the rainy season was between 28.6°C in August and 35.5°C in July, the maximum temperature being 34.2°C and minimum 23.10C during the month of October. The relative humidity varied from 73.6% - 82.9%, so that the

typical weather during July and August was muggy and sultry. From October onwards to February the weather gradually crystallizes into a pleasant and invigorating winter season with the mean temperature varying from 21.25°C in November to 15.5°C in January, the maximum temperature being 30.10°C in November, and minimum 9.0°C in December.

Rainfall: The Bundelkhand gets rains due to cyclonic storms forming in the north of Bay of Bengal and advancing along this trough. July and August were the months with heaviest rainfall (189.1 mm – 303.6 mm). Winter showers were generally experienced during the months of January and February (1.6 – 2.8 mm).

Figure-1

Map of Bundelkhand region in U.P. District
(Jhansi, Hamirpur, Jalaun, Banda, Lalitpur)



HISTORICAL REVIEW

A brief history of the work done on digenetic trematodes of freshwater fishes from India.

The first report of the digenetic trematodes of freshwater fishes of India were first reported by Southwell, T. (1913) who collected Isoparorchis hypselobagri (l. Trisimili tubis) from the air bladder of a siluroid fish, Wallago attu from Calcutta. In 1918, southwell, T. and Prashad, B. described Clinostomum piscidium from the intestine of Nandus nandus and Colisa (Trichogaster) fasciatus and I. Hypselobagri from lateral muscles of Channa (Ophiocephalus) striatus at Bengal, Poona and Ceylon.

In 1927, (Verma, S.C. (1927, 1936, a,b) described Opisthorchis pedicellata (O. mehral, O. thapari) from Rita rita and Bagarius). (B. varrelli.) Bagarius. Later on, Verma (1936a,b) also described Bucephalus aoria from Aoria (Macrones) aoria, B. tridenticularia from Aoria aoria, Aoria seengbala and Bagarius bagarius: Bucephalopsis confugus (Syn. Of B. garuai) from Pangasius buechanapi and Silundia gangetica, B. fusigormis from Eutropichthys vacha, B. garuai (B. .magnum, B. confuses, B. minimus) from Clupisoma (Pseudotropius garua and silondia gangetica, B. magnum (Syn. Of B. garuai) from Pangasius buechanani and silondia gangetica and B. minimus (Syn. Of B. garuai) from Clupisoma garua.

In 1930, Thapar, G.S. described Opisthorchis gomtil (Gomtia piscicola) from Bagarius bagarius; Thapar, G. S. and Dayal, J. (1934) reported Cotylogonoporum orfeus from Leucisens idus and Thapar 1960 described Caballeroia indica from Girrhinus fulungel.

Srivastava, H.D. added quite a large number of digenetic trematodes reported by Shrivastava H.D. he described Genarchopsis (Progonous) ovacaudatum and G. (Progonus) piscicola from Channa punctatus and G. (Ophiocorchis) singularis from Channa striatus; in 1935 (a, b, c, d), Faustula (Orientophorus) brevichrus, and F. (Orientophorus) ilishii from clupii, F. (Orientophorus) gangeticus and F. (Oriintophorus) ilishii from Hilsa hilsa (Glupea) illisha; Haplorchoides (Haplorchis) attenuatum from Mystus (Macrones) seenghala, H. (Haplorchis) gangeticum from Pseudotronius athenoides, H. (Haplorchis) silundil from silondia gangetica, H. (Haplorchis) piscicola from Eutropichthys vacha; Lecithocladium (Clupenurus) piscicola, Lecithaster Extralobus and L. indicus from Hilsa ilisha; in 1936, Asymphyrodora tincae (A. indica) from Channa punctatus; in 1937, Polyorchitrema piscicola from butropichthys vacha and in 1938 (a, b, c), Bucephalus gangeticus from Pseudotropius athenoides and Eystus seenghala, B. indicus from Mystus seenghala and Bucephalopsis belonea (Syn. Of B. karvei) from Xenentodon (Belone) strongylura; Nicollodiscus gangeticus, Orientodiscus lobatum and O. jumnai from Silondia gangetica, Phyllodistomum lewisi from Xenentodon. Strongylura

In 1933, Chatterji, R.C. described Orientocreadium (Ganada) clariae, Masenia collata and Astiotrema spinosa from Clarias batrachus; subsequently, in 1938, he reported Protocladrchis (Maccallumia) burmanica from Pangasius pangasius.

Harshey, K.R. in 1933, described Opegaster anguilli from Anguilla Bengalensis and in 1937, O. mastacambeli and O. mehrii from Mastacamballus armatus.

Pandey, B.P in 1934, described Orientocreadium indicium from Pangasius buechanani and heterobranchus longifilis and Allocreadium handiai from Channa punctatus, Pleurogenoides (Pleurogenes) pabdei from Callichrous pabda, Opegaster belivai from Gobius guirus in 1938 (a, b), Allocreadium kosia from Puntius (Barbus) chilinoideis, A. mahaseri from Puntius, A. nicolli from Gobius guiris and A. schizothoracis from Schizothorax micropogon Pandey B.P. and Shukla, R.P. (1976) described Hapalochooides pearsoni from Channa punctatus and H. mehrai from Hilsa fossilis.

In 1935, Dayal, J. reported quite a large number of new degenerate trematodes, Heplorchooides (Monorchotrema) taakree from Pseudotropius takree; in (a, b, c, d, e) Orientocreadium (Neoganada) barabankiae from Clarias batrachus, Phyllodistomum (Phyllochorus) macronius, from Mystus tengara, Astiotrema dassia from Clarias batrachus, O. (Nizamia) hyderabadii from Channa punctatus and Gorgotrema barbius from Puntius sarana; in 1942 (a, b) Eucreadium eutropichthyus from Eutropiichthys vacha, Plesiodistomum callichrius from Callichrous pabda; 1944, Neopodocotyle indica from Clarias bimaculatus; in 1948, Bucephalopsis sinhai from Eutropiichthys vacha, B. thapari from Pseudotropius taakree and Mystus seenghala, B. macronius from Mystus seenghala and Neobucephalopsis bagarias from Bagarias bagarias; in 1949, Phyllodistomum (plesiodistomum) cillichrius from Chelichorus pabda, P. vachius from Eutropiichthys vacha orientocreadium (Neoganada)

Phyllodistomum loossi from schizothorax socinus and Schizothorax sp., Allocreadium nemachilus from Nemachilus kashmirensis, A. schizothoracis from Schizothorax sp., Clinostomum schizothoraxi from Oreinus sinuatus, schizothorax niger and Schizothorax socinus and Neqscus vetastai from Oreinus sinasus, schizothorax micronagon, Schizothorax niger and schizothorax xocinus.

Gupta, S.P. reported quite a number of new flukes, in 1950 Allocreadium thapari from Rita rita: In 1951 (a, b, c, d, e), Cenhalogonimus heteropneustus from Heteropneustus fossilis, Phyllodistomum singhiai from Mastacembalus armatus; Orientocreadi (Ganadotrema) mahendrai and O. (Ganadotrema) vermai from Clarias batrachus, O. (Ganadotrema) phillinae from Channa nunctatus, Genorchonsis (Ophiocorchis) dasus and G. (Ophiocorchis) indicus from Channa punctatus G. (Ophiocorchis) faruguis from Mastacembalus armatus; O. (Macrotrema) macroni from Mystus cayasius; in 1955(a,b), Asymphyllodora (Brabmputrotrema) punctata from Channa punctatus, Phyllodistomum vittatusi from Mystus vittatus, Oudhia horai and Masenia fossilis from Heteropneustes fossilis, M. Dayali and Gouhatiana batrachii from Clarias batrachus, Thaparotrema vittalani and Assamia gauhatiensis from Rita rita, allogomtiotrema (Gomtiotrema) attui from Wallago attu, Neobucephalopsis eutropilchthys Eutropilichthys vacca, N. pseudotropil from pseudotropius garua, Hapllorchoides brahamputraensis and H. rital from Rita rita and H. gomtioensis from silondia gangetica; in 1958(a) Allocreadium mehrai from Mastacembalus aculeate and Hamacreadium (Allocreadium) kamlai from Oxygaster bacaila and in the same year (1958b) redisecribed Bucephalonsis magnum verma, (1936) Srivastava, (1938) and B.

karyei Bhalerao, (1937) in 1961, a reference list of trematodes parasites of freshwater fishes of India, with a discussion on their systematic position is given; in 1963, Allocreadium makundai from Puntius sarana and Eucreadium cameronii from Oxygaster gora. Gupta, S.P. and Agrawal, V. (1967 a, b) described Macrolecithus indicus from Puntius sophore and Asymphyiodora tincae (a. ritai) from Rita rita and in 1968, Pseudonaramacroderoides seenghali from Mystus seenghala;

Gupta, S.P. and Chakravarti, K.K. (1967) described Neopodocotyle lucknowensis from Puntius sarana; Gupta, S.P. and Verma, S.L. (1970) described Eucreadium guptai from Oxygaster bacaila, Astiotrema heteropneustusi from Heteropneustes fossilis and Helostomatis indica from Puntius sarana and in 1977, A. mrigali from Cirrhinus mrigala, A. saranai from Puntius sarana, A. baranai from Barilius barana and A. tincae (A. punctatusi) from Channa punctatus.

Srivastava, N.N. in 1951(a,b) described Eumaseenia moradabadensis from Heteropneustes fossilis, A. tincae (A. kedari) from Puntius sophore and Puntius stigma.

In 1953, Singh, K.S. described Echinostomum (Singhia) thapari from Notopterus chitala and in 1957 Diplostomum elongates from Trichogaster fasciatus.

In 1957, Chatterji, P.N. described Haplorchoides (Haplorchis) parini from Wallago attu and P. eutropiichthi from Eutropiichthys vacha.

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In 1957, Chatterji, P.N. described Haplorchoides (Haplorchis) parini from Wallago attu and P. eutropiichthi from Eutropiichthys vacha.

Jaiswal, G.P. (1957), described Phyllodistomum parorchium from Gobius giuris, P. indianum from Heteropneustes fossilis, Phyllodistomum sp. From Labeo fimbrial, Clinostomum macrosomium from Channa striatus, C. mastacembali from Mastacemblus armatus, Euclinostomum channai from Channa marulius, Echinostomum beptacaecum from Channa punctatus, Orientocreadium (Neoganada) barabankiae from Clarias batrachus, Haplorchoides attenuatum from Macrones tengara; in 1967 Derogenes sp. From Channa punctatus; Jaiswal, G.P. and Narayal, G. (1971) described Azygia maruli; from Channa marulius.

In 1958 (a, b), Saksena, J. N. reported Orientocreadium dayali and O. raipurensis from Carias batrachus, Allocreadium spindale from mastacembelus armatus and in 1960, O. Umadasi from Clarias batrachus.

In 1959, Agarwal, S.M. reported Opisthorchis pedicellata (O. mebrai, O. thapari) from Rita rita and Wallago attu. Tiwari, I.P. (1959), described Eurostomum sp. From Mastacembelus armatus. In 1960(a,b), Srivastava, P.S. described Emoleptaiea dollfusi and E. Loossi from Heteropneustes fossilis and Allocreadium ophiocephali from Channa punctatus. Gupta, P.D. and Srivastava, C.B., in 1960 reported Faustula chauhani from Hilsa ilisha.

In 1961, Motwani, M.P. and Srivastava, C.B. described Phyllodistomum chauhani (Syn. Of P. spatulaforme) from Mystus aor and Mystus seenghala and P. trinathi from Bagarius bagarius and Pseudotripius sp.

In 1962(a, b), Srivastava, C.B. described Pycnadena komiyai from Oxygaster gora, Rhynchocreadium aculeatum from Rhynchobdella aculeate; subsequently in 1963 (a, b) Bucephalus allahabadensis, B. bagarius and B. tridenticularia from Bagarius bagarius, Folliorchis vermai from Eutropiichthys vacha; in 1968, Nicolla (Crowcrocaecum) allahabadensis, N. (Crowcrocaecum) indica and O. Jamnica from Anguilla bengalensis; in 1977 he describe the hosts, distribution and relationship of Isoparorchis hypselobagri; Srivastava, C.B. and Ghosh, R. K. (1967) Paramacrolecithus rasbori from Rasbori rasbora; Srivastava, C.B. and Singh, S.P. (1967) Eucreadium jbingarani from Puntius changuino and Srivastava, C.B. and Chauhan, B.S. (1972) made a review of Indian Gasterostomes.

Rai, S.L. (1962 a, b), described Azygia stunkardi from Channa striatus and Allocreadium dollfusi, Allocreadioides hirnai and A. singhi from Barbus tor and in 1964, made observations on the life-history of Phyllodistomum srivastavai from Heteropneustes fossilis and Mystus cayasius.

In 1963, Agrawal, V. described Masenia gomia, M. vittatusia and Orientocreadium (Ganadotrema) vermai from Mystus vittatus and subsequently in 1964 (a, b), described Allocreadium heteropneustusius from Heteropneustes fossilis, Orientocreadium batrachoides and haplorchoides macronis from Macropes seenghala and Eumaseia ritai from Rita rita; Prosotocus mastacembeli from Mastacembelus armatus; in 1966 Phyllodistomum cameronii from Rita rita and Genorchopsis punctati from Channa punctatus.

In 1964, Sinha, S.S. and Pershad, R.S. reported Azygia asiatica from Ophiocephalus punctatus and also studied the development of the same.

In 1968, Kakaji, V.L. described Pleurogenoides (Pleurogenes) attui from Wallago attu, Azygia angusticauda from Mastacembalus puncatus wallago attu ophiocephalus punctatus and Ophiocephalus marulius; in 1969(a, b) Bucephalus octotentacularis, Bucephalopsis garuai Verma (1936) from Wallago attu, Cephalogonimum seenghalus from Mystus seenghala, C. heteropneustus Gupta (1951) from Heteropneustes fossilis, Phyllodistomum folium offers (1816) from Clyptosternum sp. P. spatulaeformae Odhner (1902) from Amphipnous cuchia, Polylekithum (Allocreadium) catlai from Catla catla, Orientocreadium batrachoides Tubangui (1931) from Rita rita, Macrotrema seenghali from Mystus seenghala, Fseudoparamacroderoides vittatusi from Mystus vittatus, Genorchopsis cuchiai from Amphipnous cuchia, G. cameronii from Mystus seenghala, Allocreadium fasciatusi from Trichogaster fasciatus, A. handiai from Ophiocephalus pupctatus, A. heteropneustusius from Heteropneustes fossilis and A. mehrai from Rhynchobdella aculeate.

In 1969, Sircar, M. and Sinha, D.P. described Neopodocotyle from Rita rita and in 1970, Masenia ritai from Rita rita.

In 1970 (a, b) Pandey, K.G. described Encreadium gangi from Trichogaster fasciatus, bucenhalonsis heyaglandulata and B. oxygastori from Osygaster bacaila, B. multiglandulata from Nangra

viridescens and Erethistes conta and in 1975, Neonodocotyle balliaensis from Labeo calbasu and N. dayali from Puntius sarana.

Baugh, S.C. and Chakrabarti, K.K. (1970) made a restudy of Neopodocotyle lucknowensis Gupta and Chakrabarti (1961).

Gupta, N.K. and Kumari, A. (1970 a, b, c, d, e, f), described Opisthorchis pedicellata intermedia from Mastacembelus armatus, Helostomatis cirrbini from Labeo dero and Cirrhina mrigala, Ronarthynobus nelsoni from xenentodon cencils, Hamacreadium manteri and Chelatrema symthi from Oxygaster bacaila.

In 1970, Rai, P. redescribed Allocreadium mehrai Gupta (1950) and A. bandiae Pande (1957) and in 1971 (a, b,c) described Neopodocotyle mehrai from Puntius sophore and Puntius sarana, Opisthorchis gorakhpurensis from Mystus vittatus and described the morphology and pathogenic significance of Asymphyllodora loss, 1899.

In 1972, Agarwal, G.P. and Verma, H.S. reported Eucreadium varanasi from Oxygaster gora and in 1981 Faustula makundi and F. indica from Hilsa ilisha; Agarwal, G.P. and Kumar, R. (1977) described Faustula varanasiensis from Hilsa ilisha, in 1978 Opisthorchis dayali from Rita rita, Neopodocotyle gorakhpurensis from Amphinous cuchia, in 1979 E. Thapari from Oxygaster bacaila, in 1981 Gangatrema chauhani from Mastacembelus armatus; Kumar, R. and Agarwal, G.P. in 1980 described Oudhia hardavali from Mystus vittatus and in 1981, Faustula sp. From Hilsa ilisha; Agarwal, G.P. and Agrawal, S.C. in 1978 reported Dactylostomum jhansiensis

from Mastacembelus armatus, in 1979 Orientodiscus sp. From Mastacembelus armatus, in 1980 (a. b, c) Masenia yamagutil from Rita rita, Gangatrema sp. From Rita rita. Helostomatis bundelkhandensis from Mastacembelus armatus; Agrawal, S.C. and Agarwal, G.P. in 1978 reported Dactylostomum herishii from Mastacembelus armatus, in 1981 Cephalogonimus hanumapthai from Mystus vittatus; Agrawal, G.F. and Agrawal, L.N. in 1980 reported Neopodocotyle kulpaharensis from Channa punctatus, 1981 (a,b) Eucreadium sp. From Channa punctatus, Neoeucreadium mahobaensis from Puntius sarana; Agrawal, L.N. and Agarwal, G.P. in 1981 reported Dactylostomum sp. from Mastacembelus armatus and in 1982 Pseudoparamacroderoides sp. from Mystus vittatus.

In 1973 (a, b) Verma, S.L. described Eucreadium guptai from Oxygaster bacaila, Astiotrema heteropneustusi from Heteropneustes fossilis, Helostomatis indica from Barilius barana and Stomachicola mastacembeli from Mastacembelus.

In 1976, Lal, A.K. described Jamunatrema indica from Channa punctatus. Singh, S.P. and Sinha, D.P. (1976) described Rhipidocotyle vachius from Eutropiichthys vacha, in 1977 (a, b) Bucephalus tetratentacularis from Sciaena coitre and two other species from fresh water fishes of Bihar.

In 1978, Madhavi, R. described life history of Genorchopsis goppo from Channa punctatus. Mahajan, C.L. et al. (1978) described parasitisation of Isoparorchis hypselobagri in Channa punctatus. Name H.S. in 1978 recorded Hemipera cyocaudata from Channa punctatus. Siddiqui, A.H. and Nizami, W.A. (1978) described

the incidence of Isoparorchis hypselobagri in Wallago attu and has also described its life-cycle.

In 1979, Kumar, R. made a survey of trematode parasites of fresh water fishes of Eastern Uttar Pradesh. In 1979, Singh, A.K. and Prasad, D. described Stomylotrema multiyitellaria from Mystus striatus. In 1980, Agrawal, R.K. and Agarwal, S.M. described Bucephalus indica from Bagarius bagarius. Agrawal, S.C. (1980) made a survey of trematode parasites of freshwater fishes of Bundelkhand region.

Agrawal, N. and Singh, B. (1980) reported Opisthorchis thapari from Bagarius bagarius. Gupta, V. and Furi, M. (1980) described Allocreadium calbasii from Babeo calbasu, A. manteri from Anabas testudinus and Polyorchitrema inglisi from Eutropiichthys vacha.

Ahmad (1979, 1981, 1982, 1993, and 1996) reported various parasitic helminthes of fresh water fishes in Bangladesh. He also reported diversity of helminth parasites in Catfish, major carp and Labeo rohita. Ahmed et al (1986) has studies on some aspect of biology of the genetic trematodes and nematode in five commercial fishes of the Bay of Bengal. Chandra and Golder (1987) have observed effect of helminth parasite on a fresh water fish Nandus nandus. Chandra and Banerjee (1993a, 1993b) has reported various digenetic trematodes parasite from fresh water fishes of Mymen singh. Chandra and Rahman (1988) has examined a new host record for Pallisentis ophiocephali. Moravee and sey (1988) has observed Nematodes of fresh water fishes of the Neotropical Region. Moravee and sey (1988) has noted Nematodes of fresh water fishes from North Vietnam.

Singh and Agarwal Since (1986) has noted a new host record of Ommatobephas lobatum. Singh (1986) has observed effect on haematological indices of Clarias batrachus. Singh and Jain (1987) has investigation two new monogeanans from freshwater fishes of Meerut. Singh and Singh (1987) has repted the effect Organophosphates of haematological indices of man. Singh (1987) has studied the observation on sodium and potassium in hydatid fluid of Hydetigera Rudolphi. Singh and Jain (1988) has reviewed on a new monogenetic trematodes Dogieliu gussevi n. sp. from fresh water fishes Rita rita.

Singh et al (1989) has noticed effect of alkalinity on haematological, parameters and Hepteroneuster fossilis (Bloch). Singh and Singh (1989) has observed on two new nematodes from Periplaneta americana (linn) from India. Singh and Jain (1989) has reported two fresh water monogeneans from fresh water shark, Wallago attu (Bloch & Schn.) Singh et al (1989) has reviewed the effect of starvation and refeeding on blood Chemistry of freshwater Cat fish, Heteropheuster fossilis (Bloch). Singh et al (1989) has noticed the effect of starvatoin and refeeding on haematology and hepotosomatic index of a freshwater Cat fish Heteropheustes fossil (Bloch.).

Chandra (1992a, 1992b, 1993a, 1993b, 1994a, 1994b) reported various parasite helminth of fresh water and esturanine fishes of Bangladesh. He also reported Seasonal biology and Ecology of hetropeustus in Catfish. Chandra and Banerjee (1992) has observed Opisthorchis bangarius n.sp. from a fresh water fish Bangarius

bangarius of mymensingh. Chandra and Khatun (1993) has observed a new species of Caryophyllid Cestode from Heteropneustes Fossillis of Mymensing. Khanum et al (1994) has observed Metazona infection in Glossogobius girceris.

Khanum et al (1993) has noted comparative study of parasites of Channa striatus and Channa marulius in Bangaldesh. Nahida et al (1994) has reported histopathology of infested organ in Nandus nandus. Singh and Singh (1990) has reported on a rare nematode Isobinema indica n.sp. from Grylotalpa African at Meerut.

Singh et al (1992) has studied on some Known and unknown monogeneans from Wallago attu (Bloch and Schn.) at Meerut. Singh and Sharma (1992) has observed Wallago trema indica n. sp. A new monogenean from the freshwater shark Wallago attu (Bloch and Schn.). Zamin (1994) has noted parasite fauna of Hilsa ilisha (Hamiton – Buchanan 1822) from Bangaladesh.

Ahmed and Ezaz (1997) have reported diversity of helminth parasite in the fresh water Cat fish of Bangaladesh. Chandra et al (1997) has reported some aspects of association and development of Lytocestus indicus Moghe in Catfish, Clarius batruchus (Lin) Bangaladesh. Chandra and Modak (1995) has reported Activit aging and penetration of first stage larvae of Procamallanus hetropneustus. Gibson and Bray (1997) has noted Oschmarineta Albomarina n. comb., a liver fluke from the killer whale Orcinus orca off the Prithish Coast. Gibson et al (1996) has reported guide of the parasite of fishes of Canada. Gibson et al (1996) has observed a catalogue of nominal species of the monogenean gerus Daitylogyrus Deising

(1850) and their host genera. Kohn et al (1999) has reported Chalcinotrema thatcheri n. sp. From Brazilian fresh water fishes.

Singh et al (1996) has two new species of the genus Paramazocroes Trripathi, 1959 from a fresh water fish, Sciana coitor (Ham.) Singh et al (1997) has reported three ectoparasitic monogeneans in fresh water fishes of Meerut. Singh et al (1999) has studied Cosmectocleithrum orientalis n.sp. a monogenean gill parasite of Indian freshwater fish, Wallago attu (Bloch). Zamin (1999) has noted parasite fauna of Hilsa ilisha (Hamilton Buchanan 1822) from Bangladesh.

Kostadinova and Gibson (2001) has noted redescription of two echinostomes from fresh water fishes. Singh et al (2000) has reported Wallago trema Orientalis n. sp. A new monogenean from Wallago attu Bloch & Schn., with a note on Functional and morphological peculiarities of its receptor. Singh et al (2001) has reported physiopathology of three Caryophyllacids in stinging cat fish Heteropneustes fossil (Bloch.).

Materials and Method

The digenetic trematodes, described in the thesis have been collected from the fresh water fishes in Uttar Pradesh of Bundelkhand Region. The host fishes were collected from rivers Betawa Yumuna and Ken, dams and pond and other local fresh water bodies of Bundelkhand Region. Fishes were also purchased from local fish market.

Collection of fishes was done with the assistance of fisherman available at different localities the method ranging from catching by hand to use of different type of nets fishes were also purchased from the various fish markets of region. These host fish kept alive in aquaria in the laboratory and they were freshly killed dissected and examined of convenience. A thorough search was done to determine the whereabouts of parasites of various organs viz. Gall bladder, liver and Alimentary canals were carefully examined in petridish under the low power binocular.

Soon after collection the trematodes were thoroughly washed and kept in saline water. They were studied alive and observation was made regarding the colour and movements of body spines on the body oral and ventral suckers cirrus and metraterm, excretory bladder and branches.

The fishes were taken out from the body of fish and kept separation in separation petridishes already having 0.7% physiological saline solution the organs were slit open with the help of scissor and forceps, so as to allow the flukes to loosen out the contact with the

tissue and also to settle down at the bottom of petridish. The worm were picked up with the help at a micro dropper and then processed for the fixation.

For fixation 5-10% for saline was used for whole mounts preservation in formaline for longer period gave good result. For preparing whole mount preservation was taken to avoid over or under pressure. For preparing whole mount of trematodes after fixation and through washing in water worms were dehydrated and stained in Borax Carmine then cleared in Xylene and finally mounted in DPX. The drawings of the whole mounts were made with the help of Camera lucida at a suitable magnification.

To record the seasonal incidence the fishes were examined at regular interval from March 2002 to December 2004. In all fishes per month with an average at 10 fishes of each species were examined. A total 2400 fishes were collected and studied during two year studied period.

Finally the Camera lucida sketch at each trematode was made to have much detailed information. All the measurements were taken in mm from the prepared slides with the help of an Oculometer.

Table- Host parasite list

Name of the host	Locality	Name of the digenetic trematode collected	Location of the Parasite
<u>Cirrhinus mrigala</u> (Ham.) (Cyprinidae)	Fish market Mauranipur U.P.	<u>Faustula jhansiansis</u> n.sp. <u>Faustula brevichrus</u> (Srivastava, 1935) Yamagutti, 1958	Intestine Intestine
<u>Bagarius bagarius</u> (Ham.) (Sisoridae)	Fish market Attara Banda, U.P.	<u>Bucephalus thapari</u> Agarwal, 1980	Intestine
<u>Rita rita</u> (Ham.) (Bagaridae)	River Betwa Orai, U.P. (a) Fish market Jhansi, U.P. (b) Betwa River Hamirpur, U.P. Fish market. Jalaun, U.P.	<u>Gangatrema betwai</u> Agarwal, 1980 <u>Oudhia kanungoi</u> <u>Tremiorchis ranarum</u> Mehra & negi, 1926	Intestine Intestine Intestine

<u>Catla catla</u> (Ham.) (Cyprinidae)	Fish market Jhansi, U.P.	<u>Eucreadium cameronii</u> gupta, 1963	Intestine
<u>Puntius sarana</u> (Ham.) (Cyprinidae)	River Betwa Jhansi U.P. River, Betwa, Hamirpur U.P. Fish, market, Rath Hamirpur U.P.	<u>Bundelatrema agarwali</u> n sp. <u>Gorgotrema hamirpensis</u> Agarwal, 1980 <u>Phyllodistomum vittatusi</u> Gupta, 1953	Liver Intestine Intestine
<u>Matacembelus armatus</u> (Lac) (Mastacembelidae)	Kirat Sagar Tal, Mahoba, U.P.	<u>Dactylostomum narayansis</u> n.sp.	Stomach

<u>Clarias batrachus</u> (Linn.) (Claridae)	River Yamuna Hamirpur, U.P.	<u>Orientocreadium batachoides</u> Tubangui, 1931	Intestine
<u>Oxygaster bacaila</u> (Ham.) (Cyprinidae)	Belatal, Mahoba, U.P.	<u>Helostomatis belatalensis</u> Agarwal, 1980	Intestine
<u>Channa marulius</u> (Ham.) (Ophiocephalidae)	River, Ken, Banda U.P.	<u>Opisthorchis chandrai</u> n.sp.	Gall bladder

Family: Fellodistomidae

Faustula jhansiansis n.sp.

(Fig. 2A, B, C, D)

Host	: <u>Cirrhinus mrigala</u> (Ham.)
Locality	: Fish market Mauranipur Jhansi, U.P.
No. of fishes examined	: 100
No. of fishes infected	: 4
Location	: Intestine
No. of specimens collected	: 3 + 3 + 4 + 2 = 12

DESCRIPTION

The body is a long worm like with oral and ventral sucker elongated, smooth, with blunt anterior and posterior ends. Oral sucker sub-terminal, rounded. Ventral sucker equatorial, rounded, larger than the oral sucker. Pre-pharynx absent. Pharynx globular, muscular. Oesophagus short, bifurcating into two intestinal caeca. Caeca extending up to the posterior margin of testes. Testes slightly elongated, para-acetabular. Cirrus sac extends from anterior margin of ventral sucker to the middle of oesophagus, pyriform, encloses a coiled vesicular seminalis, a short pars prostatica surrounded with numerous prostate gland cells and a short ejaculatory duct. Ovary post-testicular, seven lobed. Uterus arises from ootype, occupying whole of the post testicular area of body. Metraterm short, opening at genital pore. Shell glands few, surround the ootype. Laurer's canal not seen. Egg oval, operculated. Genital pore median, at the middle of oesophagus. Vitelline follicles 6-7 on either sides extending from the level of intestinal bifurcation up to the posterior margin of testes, from each group of vitelline follicles arises a transverse duct uniting with its fellow to form common duct which opens at ootype. Excretory bladder V-shaped, excretory pore at the hind end of body.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 1.26 – 1.62; 0.45 – 0.53; oral sucker, 0.15 – 0.18 x 0.10 x 0.12; ventral sucker, 0.18 – 0.20 x 0.15 – 0.19; pharynx, 0.08 – 0.11 x 0.07 – 0.09; oesophagus, 0.12 – 0.14; left testis, 0.15 – 0.19 x 0.10 – 0.13; right testis, 0.17 – 0.20 x 0.13 – 0.16; cirrus sac, 0.39 – 0.42 x 0.13 – 0.18; ovary, 0.23 – 0.26 x 0.15 – 0.17 egg, 0.03 – 0.05 x 0.03 – 0.04.

DISCUSSION

The present form belongs to genus Faustula. So far 13 species of the genus Faustula Poche, 1926 are known – viz. F. keksooni (Maccallum, 1918) Poche, 1926 from an unspotted ray; F. savori (Yamaguti, 1942) Yamaguti, 1958 from Hyporhamphus sayori; F. brevichrus (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. gangeticus (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. ilishii (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. clupii (Srivastava, 1935) Yamaguti, 1958 from Hilsa ilisha; F. basiri Hafeezullah and Siddiqi, 1970 from Hilsa ilisha; F. gasterostei Schell, 1973 from Gasterosteus aculeatus; F. mandapamensis Simha, 1974 from Stromateus cinereus; F. varapasiensis Agarwal and Kumar, 1977 from Hilsa ilisha; F. pyriformis Kumar, 1979 from Hilsa ilisha; F. hilsai Kumar, 1979 from Hilsa ilisha. Besides these F. makundi Agarwal and Verma, 1981 and F. indica Agarwal and Verma, 1981 from Clupea ilisha are reported recently. F. chaubani Gupta and Srivastava, 1960 has been regarded as synonym of F. brevichrus by Simha (1974). Bashirullah 1973 has also reported sternogotreme in Puntius sophore though the member of this genus are supposed to be typically parasites of marine teleosts.

The present form comes closer to F. clupii in the extension of cirrus sac from anterior and of ventral sucker to oesophageal region and in the position of genital pore but differs from it in the extension of vitelline follicles and in having only seven lobed ovaries.

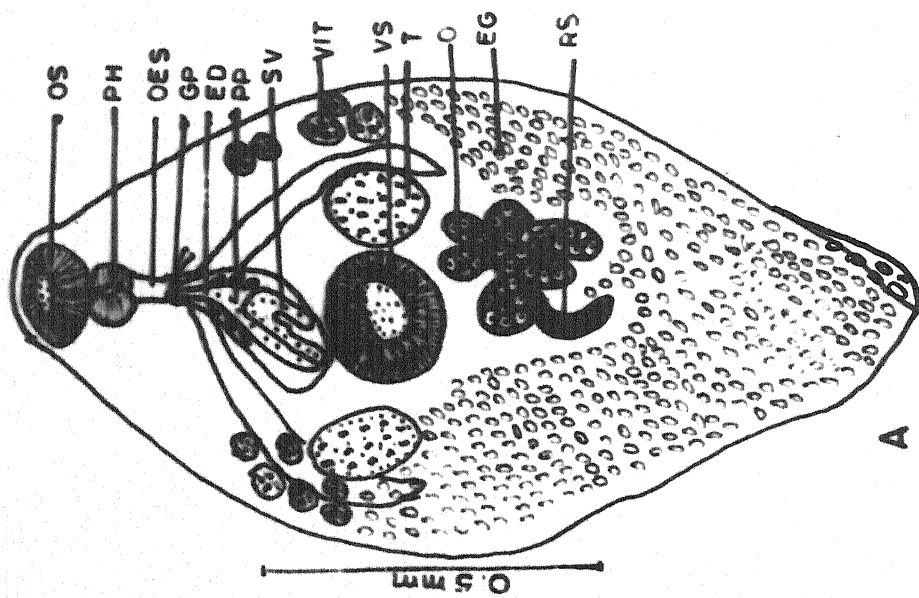
The new species is named after the name of the district and is redescribed earlier it has been reported by Poche (1926).

6. Testes lobed : F. gasterostei
Schell, 1973
- Testes entire : 7
7. Ovary entire : F. varanasiensis
Agarwal & Kumar, 1977
- Ovary lobed : 8
8. Vitellaria extend from oesophageal
region up to middle of ovary : 9
- Vitellaria extend from posterior
half of oesophagus up to little
posterior to ovary : F. mandapamensis
Simha, 1974
- Vitellaria extend from intestinal
bifurcation up to little below the
anterior margin of testes : F. pyriformes Kumar, 1979
- Vitellaria extend from post
bifurcation to middle of ventral
sucker : F. keksooni MacCallum,
1918
9. Ovary 5-6 lobed : F. hilsai Kumar, 1979
- Ovary 8 – 9 lobed : F. gangeticus
(Srivastava, 1935)
10. Ovary 6-7 lobed : F. cirrbinus, 1982 Agarwal

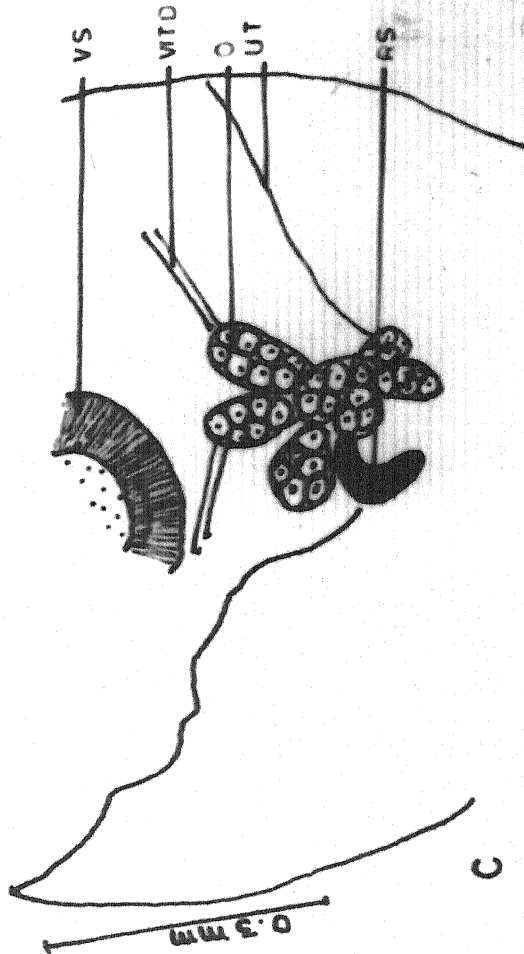
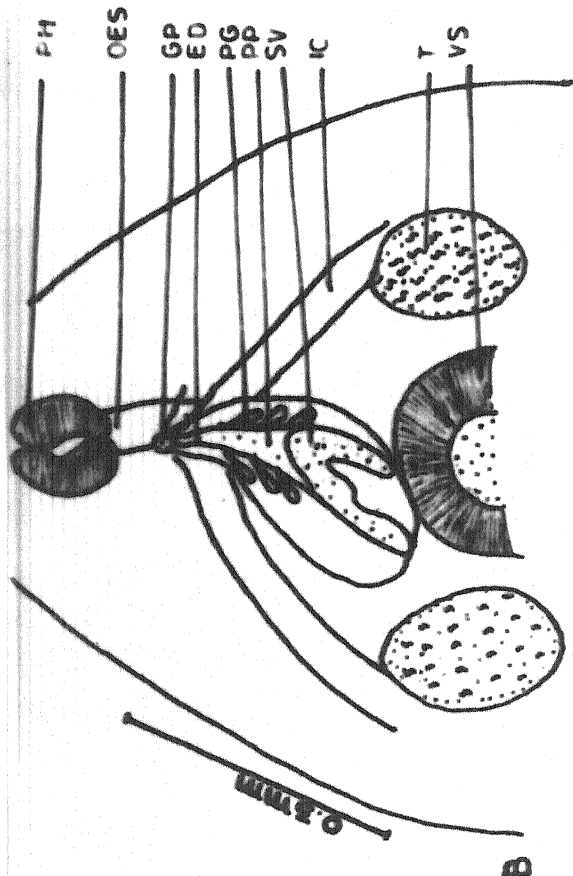
Figure -2

Faustula jhansiansis n.sp.

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



0.05 mm



Faustula brevichrus

(Srivastava, 1935) Yamaguti, 1958

(Fig. 3A, B, C, D)

Host	: <u>Cirrhinus mrigala</u> (Ham.)
Locality	: Fish market Mauraipur U.P.
No. of fishes examined	: 160
No. of fishes infected	: 3
Location	: Intestine
No. of specimens collected	: 2+1+3=6

DESCRIPTION

Body is narrow, smooth and elongated. Its anterior end is blunts. Posterior end is narrow. Oral sucker sub-terminal, rounded. Ventral sucker equatorial, rounded, larger than the oral sucker. Prepharynx absent. Pharynx globular, muscular. Oesophagus long, intestinal caeca extending beyond the level of testes. Testes reniform or oval symmetrically placed on the sides of ventral sucker more or less equal in size. Cirrus sac extends from posterior margin of ventral sucker or little posterior to ventral sucker up to the level of intestinal bifurcation, club-shaped, encloses S-shaped vesicular seminalis, a short pars prostatica surrounded with numerous prostate gland cells, an elongated narrow ejaculatory duct and a cirrus. Ovary post testicular, multilobed. Receptaculum seminis uterium, curved. Uterus arises from ootype; occupy post-vitellarian and post ovarian space of the body. Metraterm short muscular, opening at genital pore, shell glands few in number, surround the ootype. Laurer's canal not seen. Egg oval, operculated. Genital pore median, at the level of intestinal bifurcation or just post bifurcal. Vitelline follicles 6-8 on each side extend from the level of intestinal bifurcation up to middle or posterior margin of testes, from each group of vitelline follicles arises a

transverse duct opening at ootype. Excretory bladder V-shaped, excretory pore terminal.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 1.22 – 1.60; width, 0.66 – 0.75; oral sucker, 0.14 – 0.15 x 0.14 – 0.16; ventral sucker, 0.20 – 0.21 x 0.21 – 0.22; pharynx, 0.06 – 0.08 x 0.07 – 0.09; oesophagus, 0.12 – 0.15 x 0.02 – 0.03; left testis, 0.12 – 0.20 x 0.09 – 0.11; right testis, 0.12 – 0.20 x 0.09 – 0.12; cirrus sac, 0.32 – 0.36 x 0.16 – 0.17; vesicular seminalis, 0.23 x 0.04; ovary, 0.16 – 0.21 x 0.16 – 0.20; receptaculum seminis uterium, 0.10 – 0.13 x 0.04 – 0.05; egg, 0.015 – 0.018 x 0.009 – 0.012.

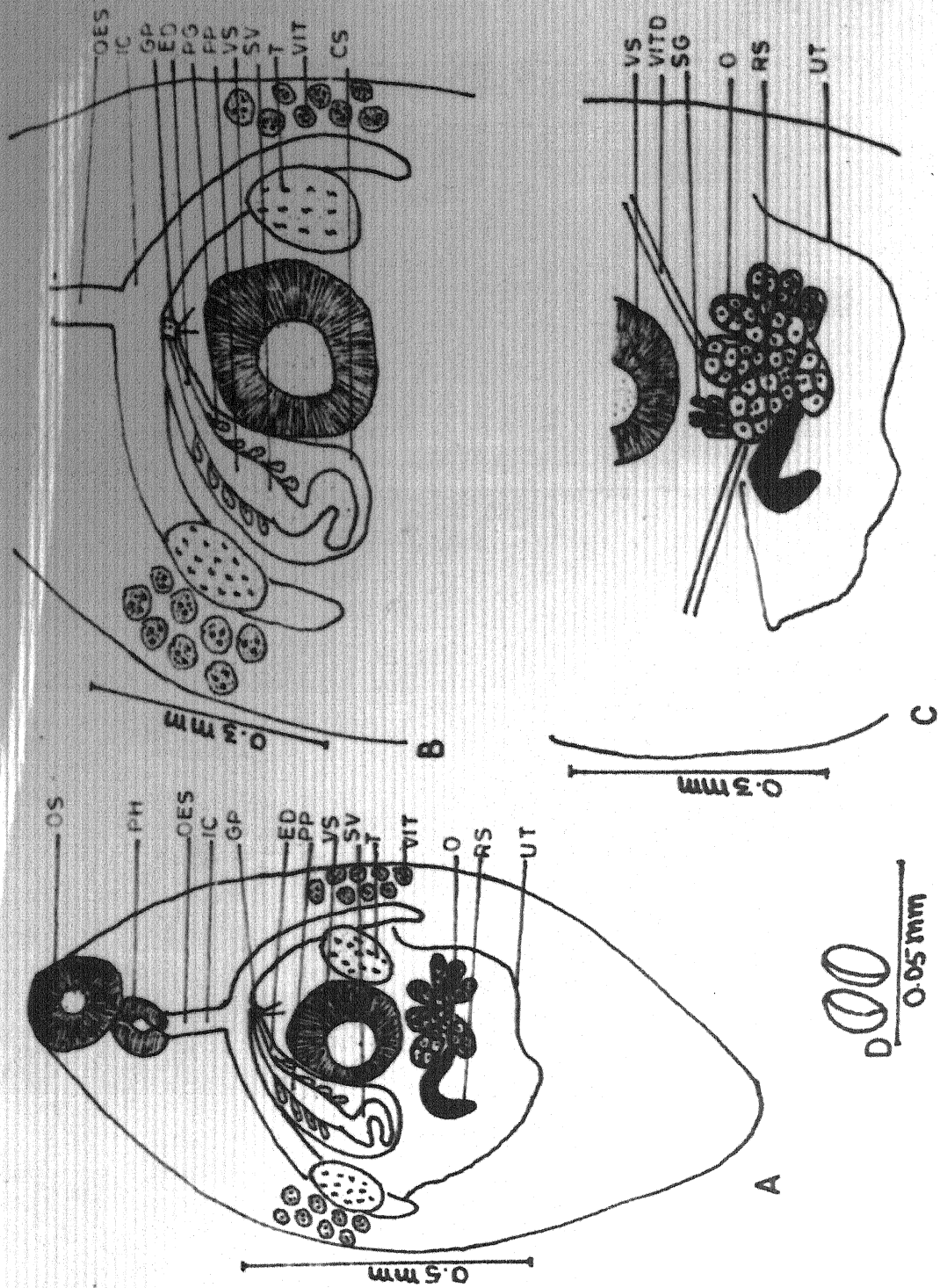
DISCUSSION

The present form belongs to Faustula brevichrus (Srivastava, 1935) Yamaguti, 1958 and is redescribed. It differs slightly in the ratio of suckers, in the extension of cirrus sac and vitelline follicles. These differences are the individual variations. This has been reported from Mauranipur, Jhansi (UP) and Panna (MP). The first report of occurrence of F. brevichrus from the other piscine host, Cirrhinus mrigala from Panna, Madhya Pradesh. Was given by Shrivastava (1935). This species is redescribed.

Figure 3

Faustula brevichrus (Srivastava, 1935) Yamaguti, 1958

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Family: Bucephalidae

Busephalus thapari Agarwal , 1980

(Fig. 4A, B, C, D)

Host	: <u>Bagarius bagarius</u> (Ham.)
Locatlity	: Fish market attara, Banda, U.P.
No. of fishes examined	: 240
No. of fishes infected	: 4
Location	: Intestine
No. of specimens collected	: 1 +2+1+2=6

DESCRIPTION

Body elongated, spinose, spines limited up to the end of posterior testis, with broad anterior and narrow posterior ends. Anterior sucker or rhynchus oval, sub-terminal with a crown of 3 tentacles with spines. Pharynx short, oval, Oesophagus short. Intestine sac-like, equatorial. Testes entire, rounded, tandem, post-equatorial, anterior testis slightly larger than posterior testis. Cirrus sac elongated, extends up to middle level of posterior testis, and encloses an oval vesicular seminalis, a saccular pars prostatica surrounded with prostate gland cells and a narrow ejaculatory duct. Ovary pear-shaped, pre-testicular, equatorial. Receptaculum seminis absent. Uterus extends up to two third of body length, leaving anterior one third of body, coils to open at genital pore through a short metraterm. Egg. Small, oval, yellow, non-operculated. Genital pore sub-median. Vitelline follicles 10-12 on each side, pre-equatorial. Excretory bladder tubular extends up to uterus, excretory pore sub terminal.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 1.48 – 1.75; width, 0.22 – 0.28; Anterior Sucker Or Rhynchus, 0.15 – 0.17 X 0.11 – 0.14; Tentacles, 0.05 – 0.15 X 0.01 – 0.02; Pharynx, 0.05 – 0.06 X 0.04 – 0.06; Oesophagus, 0.02 x 0.01; intestine, 0.12 – 0.18 x 0.06 – 0.08; anterior testis, 0.13 – 0.15 x 0.11 – 0.14; posterior testis, 0.12 – 0.14 x 0.10 – 0.14; cirrus sac, 0.32 – 0.45 x 0.06 – 0.08; vesicular seminalis, 0.05 – 0.08 x 0.04 – 0.06; pars prostatica, 0.16 – 0.20 x 0.03 – 0.04; ovary, 0.11 – 0.14 x 0.10 – 0.11; egg, 0.016 – 0.019 x 0.09 – 0.012.

DISCUSSION

So far, 20 species of the genus Bucephalus Baer, 1827 are reported including the B. pannaensis n.sp. Described in earlier pages. This family was also reported by Bashirulla and Hafizuddin (1976) in the intestine of E. murius. Of all the species, the present form comes closer to B. chillaensis Agrawal, 1980 by having 3 tentacles with spines in entire surface and in the extension of cuticular spines up to the level of posterior testis, but differs from this species in the extension of cirrus sac, shape of gonads and in the ratio of cirrus sac and body. Agarwal (1982) reported B. thapari in the intestine of Bangarias bangarias. Also Chandra and Banerjee (1993) reported B. mystusi in the intestine of Sperata aor.

It is therefore; regarded as a new species and the name of the new species are given in the honour of Dr. G. S. Thapar, a reputed Parasitologist of the country. It has been rediscrbed.

Key to the Indian species of the genus *Bucephalus* Baer, 1827

1. Tentacles 3 in number : 2
 Tentacles 4 in number : 3
 Tentacles 5 in number : 4
 Tentacles 6 in number : 6
 Tentacles 7 in number : 7
 Tentacles 8 in number : 8
 Tentacles 14-22 in number : B. aoria Verma, 1936
2. Tentacles smooth
 cuticular spines in anterior half of body: B. tritentacularia
 Srivastava, 1963
 Tentacles with minute spines at the base,
 Cuticular spines beyond equatorial region
 Of body B. bharatica Kumar,
 1979
 Tentacles with minute spines over the entire
 Surface, cuticular spines up to posterior testis 9
3. Tentacles with pointed minute spines : B. gangeticus
 Srivastava, 1938
 Tentacles short, 2 dorsal and 2 ventral,
 Without spines : B. elecatus
 Yadav, 1977
 Tentacles trident, with pointed arrow
 Head lateral processes : B. keni Agrawal, 1980
4. Ovary anterior to intestine : B. allahabadensis
 Srivastava, 1963
 Ovary lateral to intestine : 5

5. Tentacles with rose-thorn like spines
arranged radially :B. barina
Srivastava, 1938

Tentacles with simple spines at the base
and tip :B. purshottami
Kumar, 1979
6. Tentacles with 2 lateral processes, cirrus
sac extends up to anterior limit of posterior
testis :B. indicus
Srivastava, 1938

Tentacles with inwardly directed short
Processes, of ten feebly knobbed,
cirrus sac extends up to anterior
margin of anterior testis :B. jagannathi
Verma, 1936

Tentacles without lateral processes,
cirrus sac lies horizontally above the
ovary :B. indica
Agarwal & Agarwal, 1980
7. Tentacles with minute spines, cirrus
sac extends up to hind end of anterior
testis :B. pannaensis n. sp.

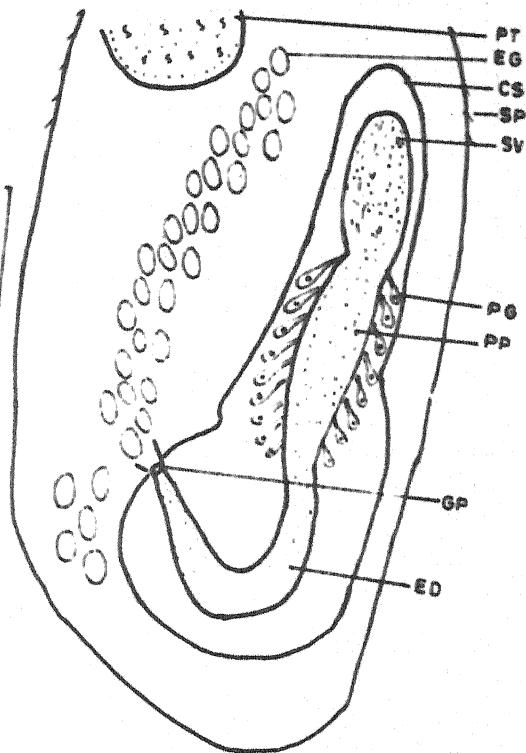
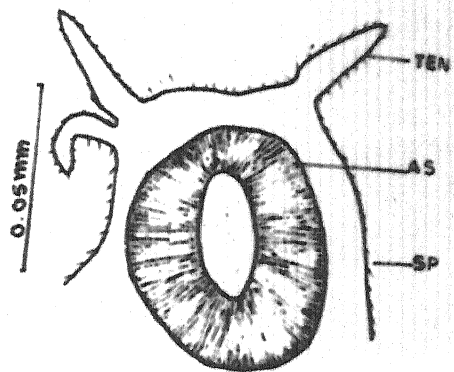
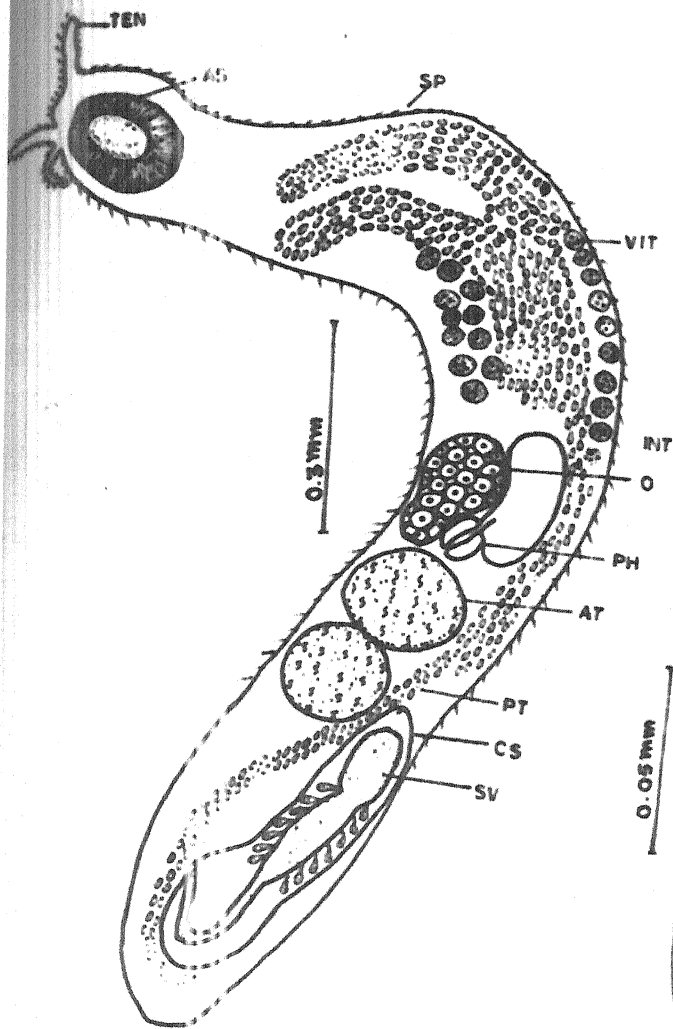
Tentacles devoid of spines, cirrus sac
Extends up to hind end of posterior
Testis :B. bagarias
Srivastava, 1963

8. Tentacles without lateral processes,
cirrus sac extends up to posterior end
of ovary :B. octotentacularia
Kakaji, 1969
- Tentacles with lateral processes, cirrus
Sac extends upto middle of anterior
Testis :B. tridentacularia
Verma, 1936
9. Cirrus sac extends up to middle of
anterior testis :B. chillaensis Agrawal, 1980
- Cirrus sac extends up to middle of
Posterior testis :B. thapari Agarwal (1982)

Figure 4

Bucephalus thapari Agarwal (1980)

- A. Ventral view
- B. Anterior sucker enlarged (drawn from live specimen)
- C. Cirrus sac enlarged (drawn from live specimen)
- D. Eggs enlarged



Family: Brachycoeliidae

Brachycoeliidae

Tremiorchis ranuram Mehra and Negi, 1925

(Fig. 5, A B, C, D)

Host	: <u>Rita rita</u> (Ham.)
Locality	: Fish market Jalaun, U. P
No. of fishes examined	: 85
No of fishes infected	: 3
Location	: Intestine
No. of specimen collected	: 1+1+2=4

DESCRIPTION

Body elongated, spinous, with narrow anterior and blunt posterior ends. Oral sucker sub-terminal, oval or rounded. Ventral sucker pre-equatorial, rounded, larger than oral sucker. Pre-pharynx absent. Pharynx globular. Oesophagus long, variable in length. Intestinal caeca extending up to the margin of anterior testis smaller than the posterior one. Cirrus sac extend from anterior margin of ovary up to below the level of intestinal bifurcation, curved, enclosing an oval vesicular seminalis, a long ejaculatory duct. Ovary spherical, pre-equatorial, smaller than the testes. Receptaculum seminis oval at genital pore by a prominent metraterm. Shell glands numerous, surround the ootype. Laurer's canal present. Egg oval, non-operculated. Genital pore post-bifurcal, sub-median, just in front of ventral sucker or close to intestinal bifurcation. Vitelline follicles extend from middle of ventral sucker or little posterior to ventral sucker either up to anterior or up to posterior end of anterior testis, two vitelline ducts unite to form a yolk reservoir. Excretory bladder y-shaped, excretory pore terminal.

MEASUREMENTS

(All measurements were taken in mm)

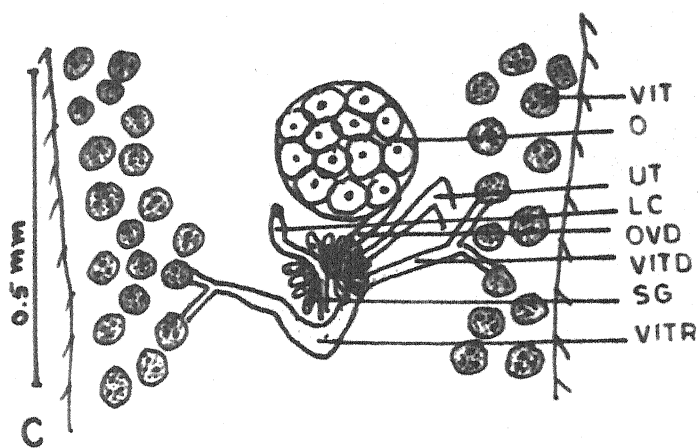
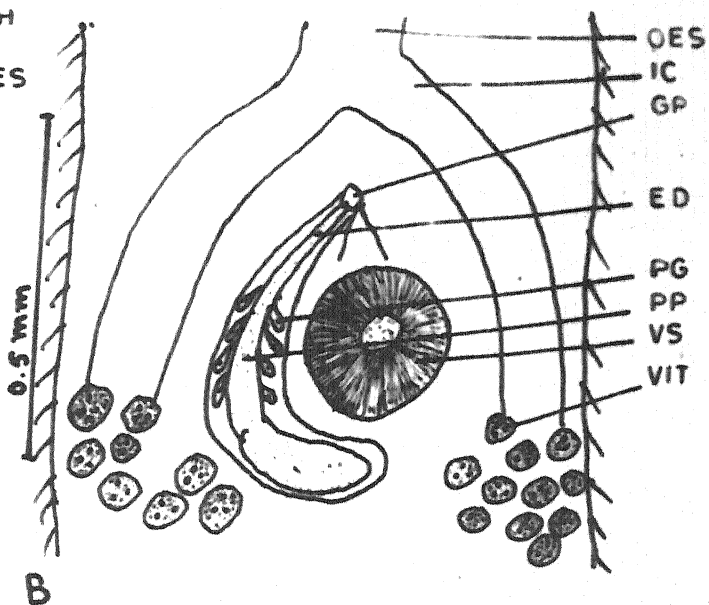
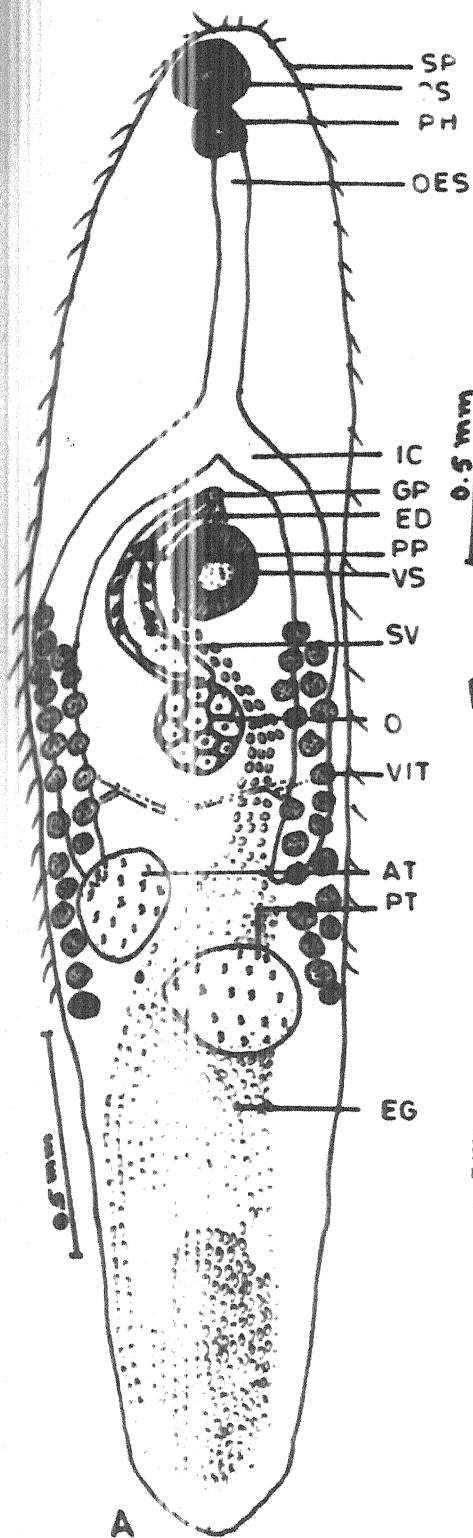
Body length, 3.42 – 3.49; width, 0.70 – 0.78; ventral sucker, 0.20 – 0.26 x 0.21 – 0.28; pharynx, 0.12 – 0.15 x 0.09 – 0.10; oesophagus, 0.38 – 0.52 x 0.10 – 0.12; anterior testis, 0.26 – 0.28 x 0.21 – 0.28 x 0.21 – 0.25; posterior testis, 0.35 – 0.40 x 0.29 – 0.34; cirrus sac, 0.65 – 0.78 x 0.09 – 0.12; vesicular seminalis, 0.27 – 0.38 x 0.06 – 0.08; pars protatica, 0.12 – 0.18 x 0.04 – 0.06; ejaculatory duct, 0.12 – 0.15 x 0.03 – 0.04; ovary, 0.19 – 0.23 x 0.20 – 0.22; receptaculum seminis, 0.09 – 0.10 x 0.09 – 0.11; egg, 0.02 x 0.01.

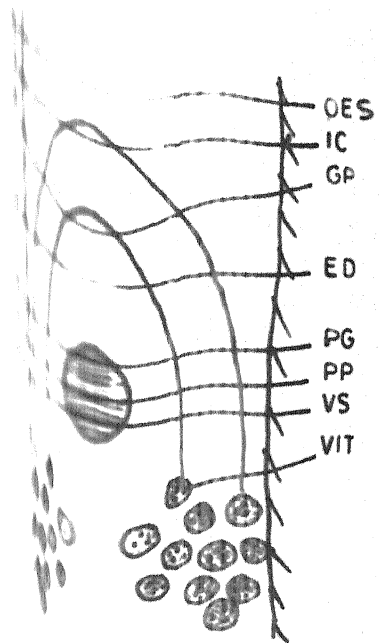
DISCUSSION

The present form belongs genus Tremiorchis Mehra and Negi, 1926 was included in the sub-family Plagiorchiinae Partt, 1902 of the family Plagiorchiidae (Luhe, 1901) ward, 1917. Subsequently, workers like Bhalero (1926), Mehra (1937), Yamaguti (1958), Agarwal (1966), Fotedar (1970) and Sinha and Sahay (1971) etc. have also followed Mehra and Negi, 1926. However, Yamaguti (1971) revised this classification and removed the genus Tremiorchis from the family Plagiorchiidae to include it in the sub-family brachycoellinae Looss, 1899 of the family Brachycoellidae Johnston, 1912. Recently, Kalyankar and Palladwar (1977) have also followed Yamaguti (1971) and retained the genus Tremiorchis including the excretory system; show its close resemblance with several other genera of the sub-family Brachycoeliinae of the family Plagiorchiidae.

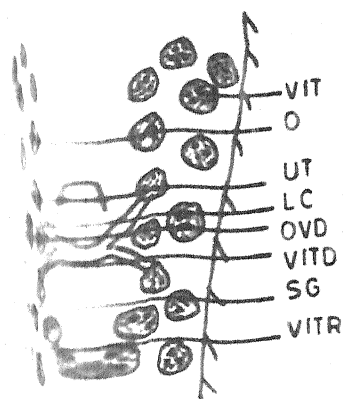
The species of genus Tremiorchis Mehra and Negi, 1926 have been mainly reported from amphibian hosts (frog) by a number of Indian workers except T. vanarum Verma, 1930 which has been reported from a reptilian host. Kumar (1979) recorded Tremiorchis ranarum from a piscine host, Channa magulius (Ham.) and Agarwal (1980) from Puntius sarana (Ham.) at Jhansi. The present report of T. ranarum is also from a piscine host Rita rita (Ham.) at Hamirpur.

Since earlier workes like Bhalaro (1970), Singh (1954), Bhardwaj (1963), Agarwal (1966), fotedar (1970), Ali and Karyakaarte (1970), Mukerji and Ghosh (1970), Sinha and Sahay (1971), Karyakarte (1972) and Pande (1975) have recorded variations in various body organization of the genus, therefore, the differences of these features in the present specimens are also considered variable. The present form slightly differs from the type species T. ranarum Mehra and Negi, 1926 in various body measurements, in the length of oesophagus, in the extension of vitelline follicles. Therefore, a description of the species has been made and Rita rita (ham.) is added as an additional host. It has been redescribed.





Family: Gorgo



Family: Gorgoderidae

Gorgotrema hamirprens Agarwal (1980)

(Fig.6A, B, C, D)

Host	: <u>Puntius sarana</u>
Locality	: River Betawa Hamirpur, U.P.
No. of fishes examined	: 190
No. of fishes infected	: 5
Location	: Intestine
No. of specimens collected	: 1+1+2+3+1=8

DESCRIPTION

Body is ribbon like dorsoventrally flattened, anterior portion narrower, elongated, as compared to posterior which is broader and expanded. Oral sucker sub-terminal, having funnel-shaped. Ventral sucker rounded, smaller than oral sucker. Pre-pharynx absent. Pharynx not present. Oesophagus short, Intestinal caeca broad, terminating short of posterior extremity. Testis in two blocks, each consist of small rounded follicles, scattered in the mid-broad region of body. Cirrus sac absent Vesicula seminalis oval, free in parenchyma. Ejaculatory duct small. Open into genital atrium. Ovary slightly irregular, situated on the right side of the right vitelline gland. Uterus arises from the posterior side of the ootype between the opening of the vitelline ducts and runs backwardly forming coils between the intestinal caeca and anteriorly dorsal to ventral sucker to open at genital atrium. Egg oval, with a thin light shell. Genital pore median, situated right at the intestinal bifurcation, leads into a common genital atrium. Vitelline gland consist of two large undivided follicles, situated in the middle of body on either side of ootype behind the ventral sucker, the ducts from the two gland open separately at the ootype. A larger number of shell gland surround the ootype. Excretory vesicle tubular, excretory pore near the end of body.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 2.85 – 3.51; width, 1.48 – 1.63; oral sucker, 0.23 – 0.26 x 0.24 – 0.27; ventral sucker, 0.17 – 0.19 x 0.16 – 0.18; oesophagus, 0.25 – 0.28 x 0.06 – 0.08; anterior testis, 0.26 – 0.28 x 0.21 – 0.28 x 0.21 – 0.25; posterior testis; vesicular seminalis, 0.08 – 0.09 x 0.03 – 0.05; ovary 0.12 – 0.15 x 0.08 – 0.11; egg, 0.015 – 0.018 x 0.010 – 0.012

DISCUSSION

The present form belongs to genus Gorgotrema was established by Dyal, 1938 from a fresh water fishes Barbus sarana with the type species G. barbius. The present form chiefly differs from it in having comparatively short oesophagus, in the shape of ovary and in the position of genital pore. Chandra and Banerjee 1993 has also reported presence of Phyllodistomum chuhani in the intestine of Channa punctatus. Beside this a number of workes have reported various species of Gorgotrema in Clarias batrachus, Glossogobius giurius and Ompok bimeculatus (Ahmad and Begam 1978, Ahmed 1981, Khanum et al 1992 and 1994). Some parasites are also reported in urinary bladder, and swimbladder of Rita rita and Channa marulius (Ahmed and Bagam 1978, Bashirullah and Islem 1970, Ahmed and Ezaz 1997)

The species G. hamirpurensis, is named after the locality of the host. It has been rediscrined

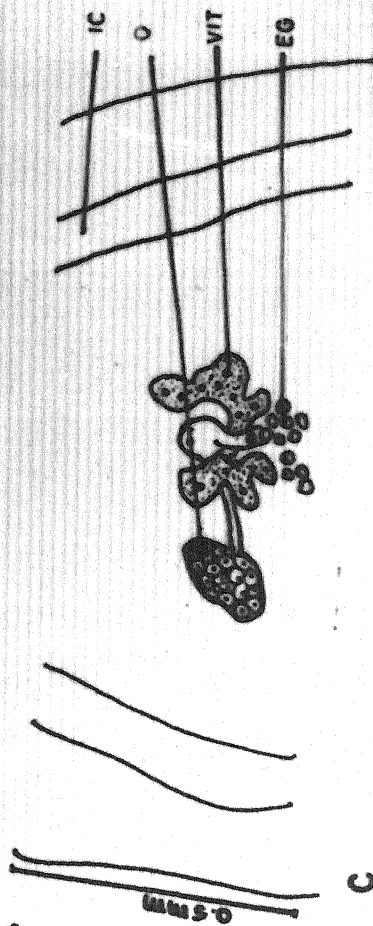
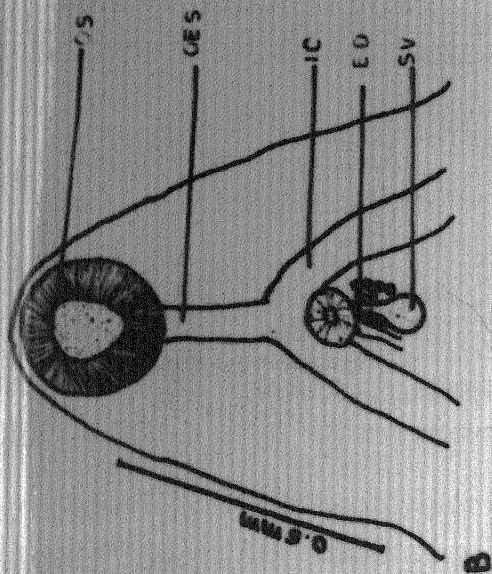
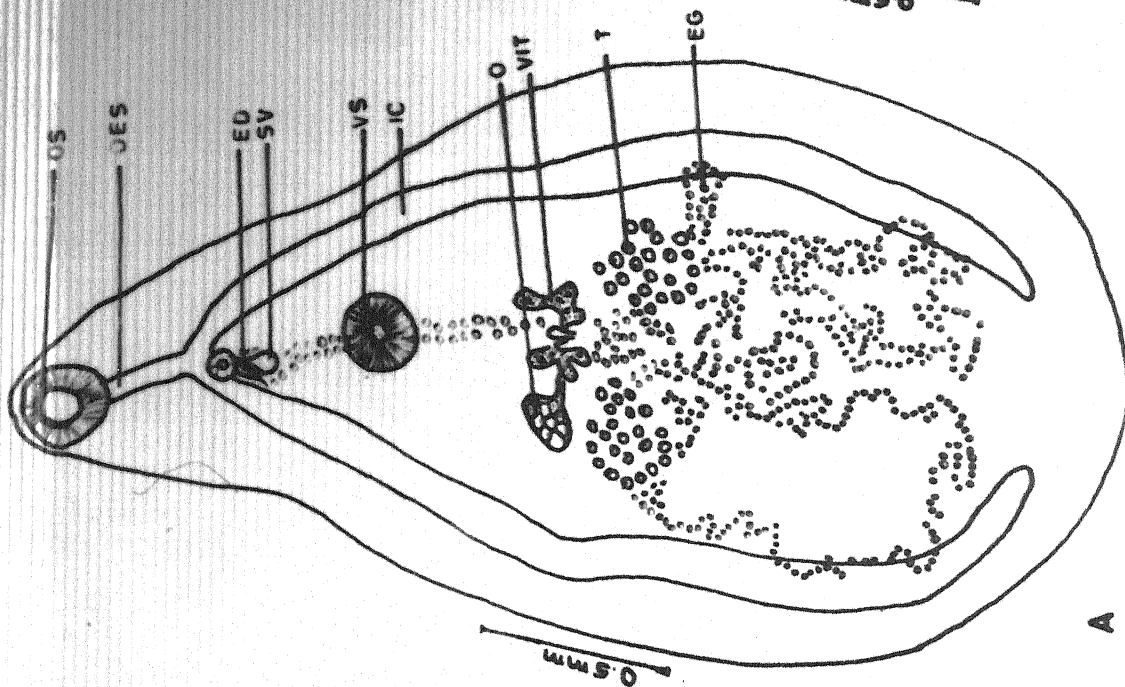
Key to the species of genus *Gorgotrema* Dayal, 1938.

1. Ovary oval,
Genital pore at oesophageal
Region : *G. barbius* Dayal, 1938
2. Ovary triangular,
Genital pore median at
Intestinal bifurcation : *G. hamirpurensis* Agarwal,
(1982)

Figure-6

Gorgotrema hamirpurensis Agarwal (1980)

- A. Ventral view
- B. Anterior part of body showing Cirrus sac enlarged (drawn from live species)
- C. Ovary and ootype enlarged (drawn from live species)
- D. Eggs enlarged



DOO
0.05 mm

Phyllodistomum vittatusi Gupta, 1953

(Fig. 7A, B, C, D)

Host	: <u>Puntius sarana</u> (Ham.)
Location	: Fish market Rath, Hamirpur U.P
No. of fishes examined	: 100
No. of fishes infected	: 4
Location	: Intestine
No. of specimens collected	: 1+1+2+2=6

DESCRIPTION

Body smooth with narrow anterior and expanded posterior ends. Oral sucker oval sub-terminal, larger than ventral sucker. Ventral sucker rounded, situated in anterior third of body. Pre-pharynx absent. Pharynx absent Oesophagus short. Intestinal caeca broad, terminate a little in front of the hind end. Testes larger or smaller than ovary, irregular, inner-caecal, tandem obliquely one behind the other. Cirrus sac absent. Vesicula seminalis free in parenchyma, opens in to a small vesicular pouch in to which uterus also open. Ovary oval, situated on the left side of the vitelline gland. The uterus arises from the posterior side of ootype between the vitelline ducts, runs backward, fills up nearly all the space of the body posterior to vitelline gland, forming numerous coils, anteriorly runs dorsal to the ventral sucker to open in to the small circular genital pouch which open outside at genital pore. Egg oval, with a thin light brown shell. Genital pore lies between intestinal bifurcation and the ventral sucker. The vitelline gland consists of two lobed follicles lying at some distance behind the acetabulum, symmetrically one on either side of the ootype, intercaecal in position. Excretory bladder tubular, excretory pore terminal.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 4.81 – 5.52; width, 3.15 – 3.69; oral Sucker 0.46 – 0.49 x 0.26 – 0.29; Ventral sucker, 0.31 – 0.34 x 0.30 – 0.32; Oesophagus, 0.42 x 0.43 x 0.09 – 0.10; Vesicula seminalis, 0.21 – 0.24 x 0.05 – 0.06; ovary, 0.42 – 0.45 x 0.31 – 0.35; egg, 0.018 – 0.019 x 0.011 – 0.012.

DISCUSSION

The present form belongs to Phyllodistomum vittatusi Gupta, 1953 but slightly differs in the size of oesophagus and testes being larger variable features. This is also being recorded from Rath, Hamirpur. It has been redescribed

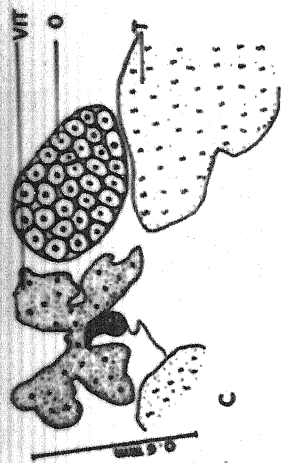
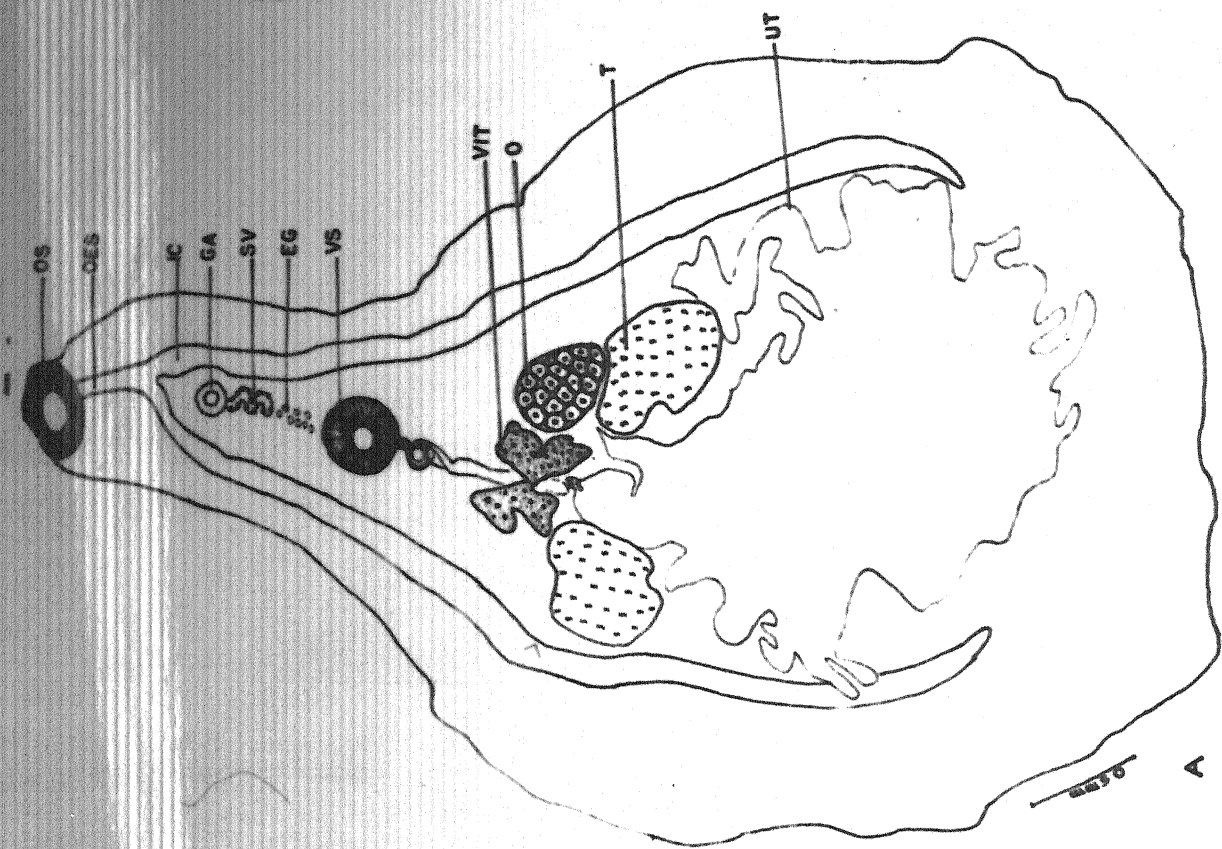
MEASUREMENTS

(All measurements were taken in mm)

Body length, 4.81 – 5.52; width, 3.15 – 3.69; oral Sucker 0.46 – 0.49 x 0.26 – 0.29; Ventral sucker, 0.31 – 0.34 x 0.30 – 0.32; Oesophagus, 0.42 x 0.43 x 0.09 – 0.10; Vesicula seminalis, 0.21 – 0.24 x 0.05 – 0.06; ovary, 0.42 – 0.45 x 0.31 – 0.35; egg, 0.018 – 0.019 x 0.011 – 0.012.

DISCUSSION

The present form belongs to Phyllodistomum vittatusi Gupta, 1953 but slightly differs in the size of oesophagus and testes being larger variable features. This is also being recorded from Rath, Hamirpur. It has been redescribed



Family: Opecoelidae

Dactylostomum narayansis n.sp.

(Fig. 8A, B, C, D,)

Host	: <u>Matacembelus armatus</u> (Lac)
Locality	: Kirat sagar Tal, Mahoba, UP
No. of fishes examined	: 200
No. of fishes infected	: 4
Location	: Stomach
No. of specimens collected	: 2+1+3+2=8

DESCRIPTION

Body elongated, smooth, tapering anteriorly and rounded at posterior end, Oral sucker terminal, oval, Ventral sucker large, muscular, pedunculated with two dactyls, Pre-pharynx present, Pharynx rounded, muscular, Oesophagus long, tubular, intestinal caeca fused posteriorly to form cyclocoel. Testes oval, tandem, currys lacking. Vesicular seminalis lies freely in parenchyma, close to ventral sucker. Ovary rounded or oval, Pre-testicular, equatorial. Receptaculum seminis rounded, Uterus intercaecal, limited between ootype to genital pore, opens through a metraterm at genital pore. Egg oval, operculated, yellow. Genital pore near the intestinal bifurcation.

MEASUREMENTS

(All measurements were taken in mm)

Body length; 2.50 – 3.92; width, 0.54 – 0.39; oral sucker; 0.17-0.21 x 0.18 – 0.20; ventral sucker; 0.28- 0.39 x 0.30-0.41; dactyles; 0.08- 0.10 x 0.05; pre-pharynx; 0.06-0.12 x 0.03-0.04; pharynx; 0.04-0.09 x 0.03- 0.05; oesophagus; 0.09-0.20 x 0.02-0.05; anterior testis, 0.28-0.43 x 0.30-0.38; posterior testis, 0.39- x 0.34 – 0.42; ovary, 0.17-0.23 x 0.18; receptaculum seminis, 0.13-0.15 x 0.19-0.20; egg, 0.06-0.03-0.04.

DISCUSSION

Woolcock established the genus Dactylostomum in 1935 with the type species D. gracile from a marine fish Myxus elongatus from Australia. Subsequently, five more species were added to this genus viz. D. Vitellosum Manter, 1940 from an unidentified marine fish from Columbia; D. caballeroi Martin, 1960 from a marine fish Pseudupeneus fraterclus from Hawaii; D. Winteri Caballero and Caballero, 1971 from a marine fish Paralabrax maculatofasciatus from Mexico; D. harishii Agrawal and Agarwal, 1978 and D. jhansiensis Agrawal, 1980 from a fresh Water. Fish Mastacembelus armatus from Jhansi (India).

The new species mainly differs from all other species in the number of dactyles on the ventral sucker and in the position of genitalpore except D. jhansiensis. It further differs from D. gracile, in the extension of vitelline follicles; in having short oesohagus excep in D. jhansiensis and also differs from D. caballeroi and D. winery in having the stalked ventral sucker. A number of workers have worked on various parasites of family opecolidae and reported their presence in stomach intestine and Swim bladder of Channa panctatus and Heteropneustes fossils Bashirulla and Elahi (1972), Bashirulla (1973).

Ahmed and Saha 1983, Ahmed 1981, Akther et al 1997, Bashirulla and Elahi 1972 also reported presence of Crow crocaecum species in the intestine of Channa maruliun. Also Opegaster sp was reported in Glossogobius giuris stomach and intestine (Ahmed and Saha 1983).

This new species is named as Dactylostomum narayansis in honour of my father Prof. Jay Narayan Singh.

Key to the species of the genus Dactylostomum Woolcock. 1935.

1. Ventanal suker sessile : 2
 Ventral sucker stalked : 3

2. With 4 clsters of 4 dactyles
 and 4 isolated dactyle : D. caballoi
Martin , 1960

 With 3 Small dactyls : D. Winteri
 Ballo & Caballo, 1971

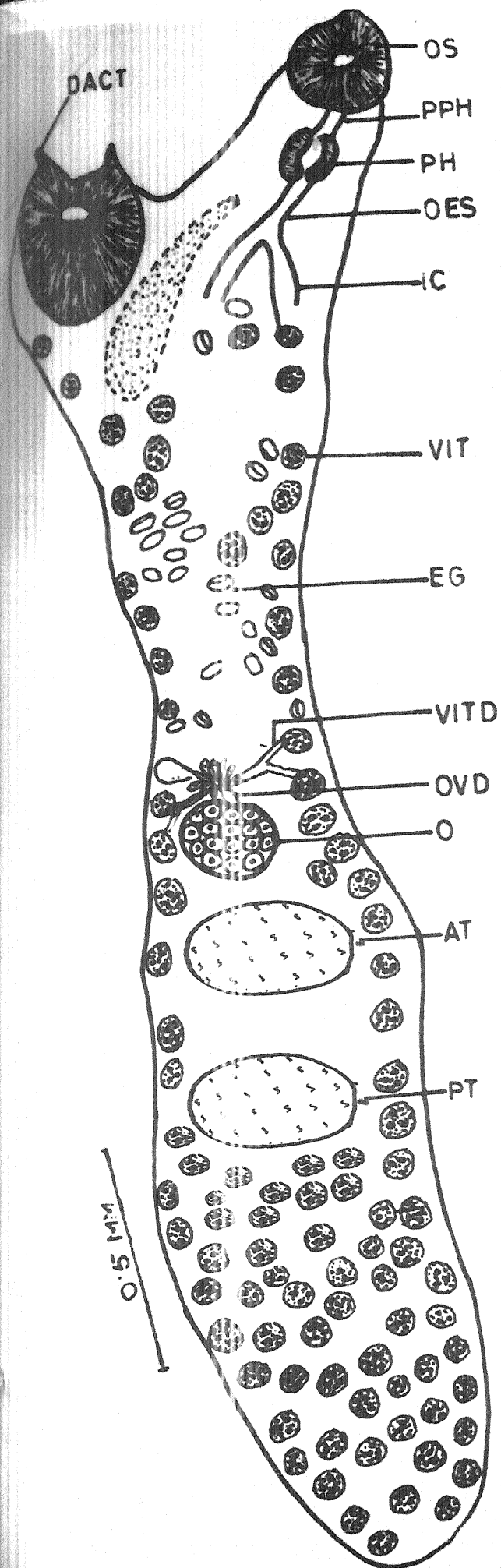
3. With 2 Small dactyls : D. Mastacembeli.n.sp
 With 4 dactyles : D. harishii
 Agrawal & Agarwal 1978

 With 3 large round, median
 lobes 6 papillae like
 elevations 3 on each side : D. Vitellosum
 Manter1940

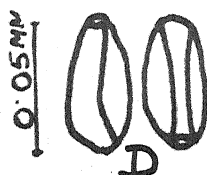
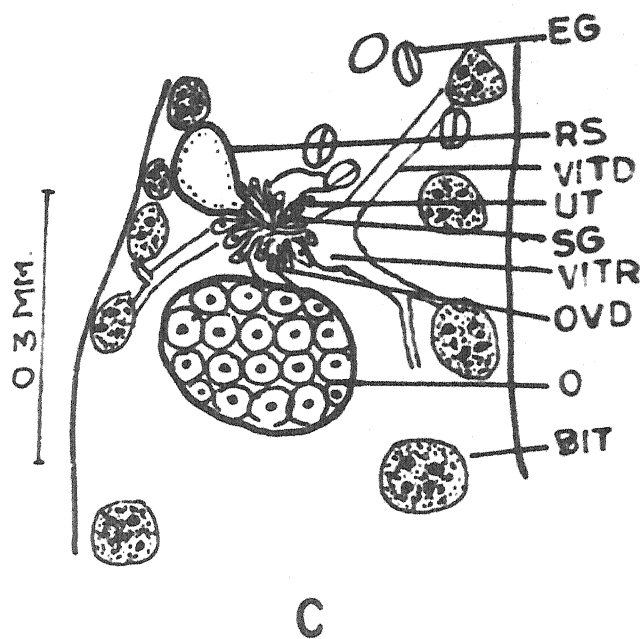
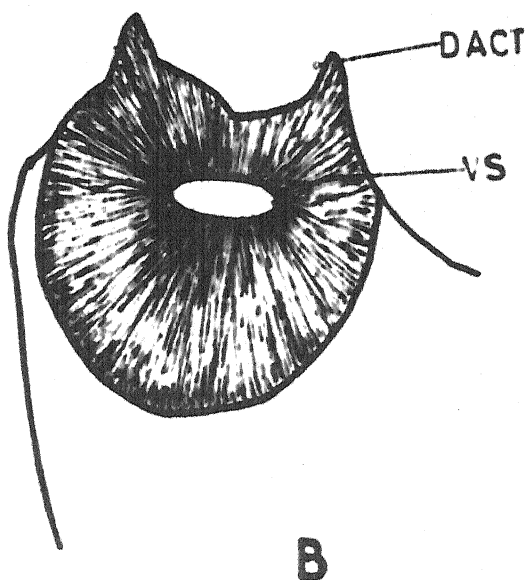
 With 6 dactyles : 4

4. Oesophagus small, vitelline follicies extend from
 a distance below the level of intestinal bifurcation up
 to posterior end of body : D. gracile
 Woolcock, 1935

 Oesophagus moderately long, vitelline follicles
 extend from the level of intestinal bifurcation
 up to posterior end of body : D. Jhansiensis
 Agrawal, 1980



0.3 mm



Gengatrema betwai Agarwal, 1980

(Fig. 9A, B, C, D)

Host	: <u>Rita rita</u> (Ham)
Locality	: River Betwa, Orai, U.P.
No. of fishes examined	: 200
No. of fishes infected	: 3
Location	: Intestine
No. of specimens collected	: 2+1+2=5

DESCRIPTION

Body smooth, elongated with rounded anterior and blunt posterior ends. oral sucker sub-terminal, rounded. Ventral sucker pre-equatorial, rounded, larger than oral sucker. Pre-pharynx short. Pharynx globular, muscular. Oesophagus long, tubular. Intestinal caeca up to hind region of body, fused posteriorly to form cyclocoel. Testes irregular or triangular, tandem, post-equatorial, anterior testis slightly smaller than posterior testis. Cirrus sac large, pre-equatorial, encircling the entire right posterior lateral side of ventral sucker, ends at the mid level of oesophagus on left side, slightly curved, enclosing a bilobed vesicular seminalis, an oval pars prostatica surrounded with numerous prostate gland cells and a long narrow ejaculatory duct. Ovary oval, pre-testicular. Receptaculum seminis preovarian, median, sac-like. Uterus limited, equatorial, confined in between the level of ovary to ventral sucker, opens at genital pore by a metraterm. Shell glands numerous, surrounding the ootype. Laurer's canal not seen. Egg oval, yellow, operculated, without polar filament. Genital pore sub-median, on left of mid-oesophageal region. Vitelline follicles extend from pharyngeal region up to hind end of body. Two vitelline ducts unite with each other before opening at ootype. Excretory bladder tubular, excretory pore at the mid end of body.

MEASUREMENTS

(All measurements were taken in mm)

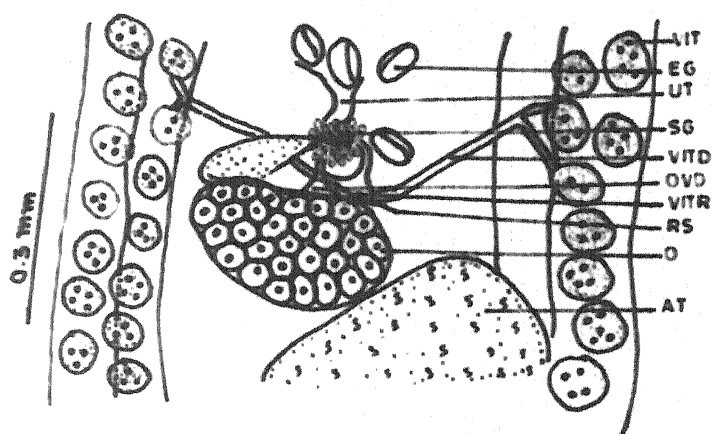
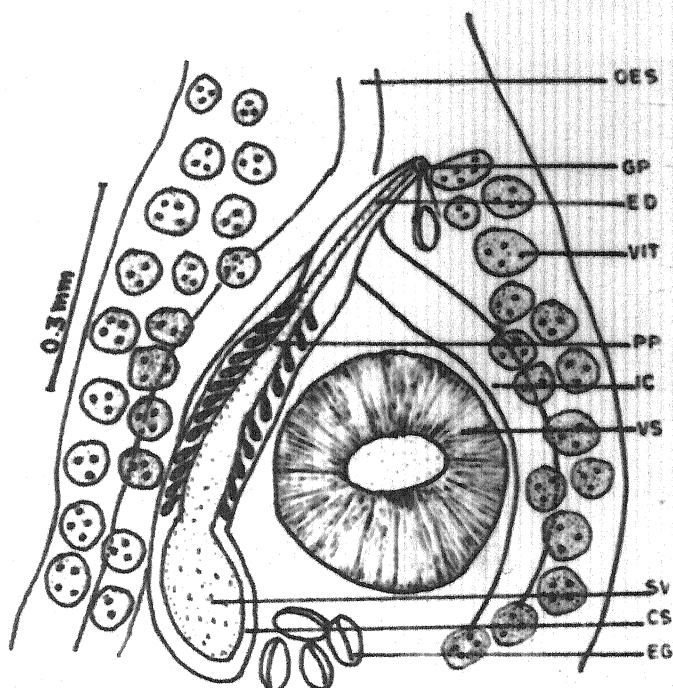
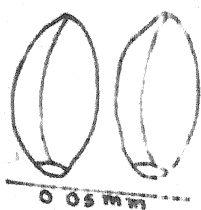
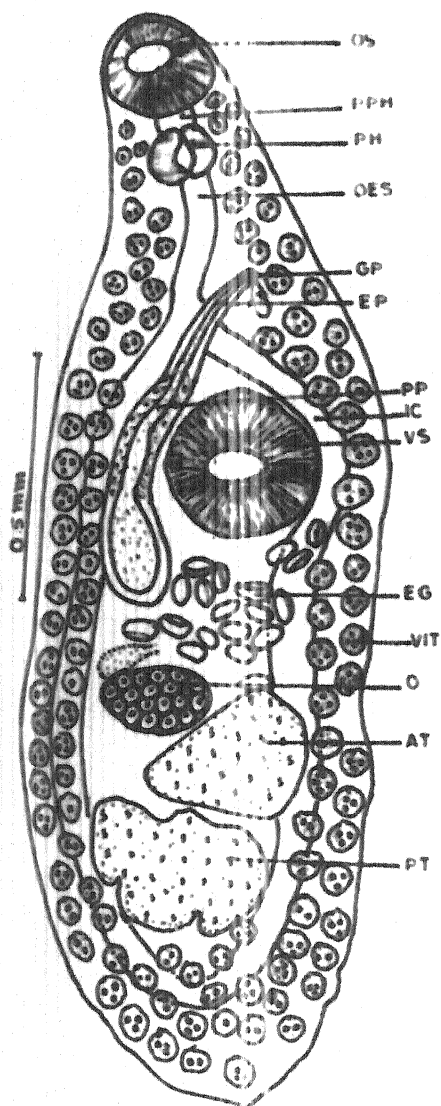
Body length, 2.46 – 2.56; width, 0.75 – 0.82; oral sucker, 0.16 – 0.20 x 0.16 – 0.21; ventral sucker, 0.31 – 0.35 x 0.31 – 0.32; pre-pharynx, 0.05 – 0.08 x 0.04 – 0.09; pharynx, 0.13 – 0.12 x 0.11 – 0.12; oesophagus, 0.24 – 0.27 x 0.06 – 0.08; anterior testis, 0.27 – 0.45 x 0.27 – 0.38; posterior testis, 0.41 – 0.47 x 0.35; cirrus sac, 0.89 – 0.91 x 0.13 – 0.15; vesicular seminalis, 0.41 x 0.35; cirrus sac, 0.89 – 0.91 x 0.13 – 0.15; vesicular seminalis, 0.41 – 0.42 x 0.08 – 0.12; pars prostatica, 0.27 – 0.28 x 0.05 – 0.06; ovary, 0.21 – 0.31 x 0.13 – 0.15; receptaculum seminis, 0.10 – 0.12 x 0.08 – 0.09; egg, 0.04 x 0.06.

DISCUSSION

Genus Gangatrema was established by Agarwal and Kumar (1981) with type species G. chauhani from the intestine of a freshwater fish, Mastacembelus armatus (Lac.) Subsequently, one more species G. ritai from the intestine of a fresh water fish, Rita rita (Ham.) was added by Agrawal (1980).

The present form mainly differs from the two known species in the extension of vitelline follicles and in ratio of sucker. It further differs from G. chauhani in the extension of cirrus sac up to middle of oesophageal region and from G. ritai in the shape of gonads. It has been redescribed.

The name of the species is given after the locality of host.



Eucreadium cameronii Gupta, 1963

(Fig. 10A, B, C, D)

Host	: <u>Catla catla</u> (Hem)
Locality	: Fish market Jhansi, U.P.
No. of fishes examined	: 80
No. of fishes infected	: 4
Location	: Intestine
No. of specimens collected	: 3 + 3 + 2 + 2 = 10

DESCRIPTION

Body elongated, unarmed, rounded at both the ends. Oral sucker sub-terminal, oval or spherical. Ventral sucker larger than oral sucker, spherical, pre-equatorial, Pre-pharynx small Pharynx muscular oval or rounded. Oesophagus short, straight or slightly curved. Intestinal caeca extending more or less up to the posterior end of the body or up to the hind level of posterior testis, testes 3-6 lobed or irregular, tandem, intercaecal, nearly post-equatorial. Cirrus sac post-bifurcal, extends up to middle of ventral sucker, saccular or curved, encloses a spiral or lobed vesicular seminalis, a globular or tubular pars prostatica surrounded with prostate gland cells and a short tubular ejaculatory duct. Genital pore median or submedian or at intestinal level, pre-acetabular, ovary round, spherical or triangular, placed lateral to ventral sucker or post acetabular, Receptaculum seminis pear shaped. Uterine coils pre-testicular, uterus ends at the genital pore by metraterm. Egg oval, operculated, pointed at opercular end. Vitelline follicles numerous, small, extending from middle of oral sucker to posterior end of body, two vitelline ducts unite in front of anterior testis to form a vitelline reservoir which opens at the ootype by a common vitelline duct. Excretory vesicle tubular, extending from hind end of anterior testis to excretory pore.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 2.31 – 3.02; width, 0.53 – 1.04; oral sucker, 0.31 – 0.35 x 0.30 – 0.33; ventral sucker, 0.30 – 0.54 x 0.34 x 0.56; pre-pharynx, 0.05 – 0.06 x 0.05 – 0.06; pharynx, 0.11 – 0.21 x 0.11 – 0.23; oesophagus, 0.13 – 0.26 x 0.03 – 0.06; anterior testis, 0.31 – 0.39 x 0.17 – 0.49; posterior testis, 0.14 – 0.46 x 0.17 – 0.36; cirrus sac, 0.14 – 0.24 x 0.03 – 0.05; vesicular seminalis, 0.17 – 0.21 x 0.04 – 0.06; pars prostatica, 0.03 – 0.06 x 0.03 – 0.05; ejaculatory duct, 0.02 – 0.03 x 0.03 – 0.05; ovary, 0.12 – 0.18 x 0.23 – 0.33; receptaculum seminis, 0.09 – 0.10 x 0.26 – 0.32; egg, 0.06 – 0.09 x 0.03 – 0.05.

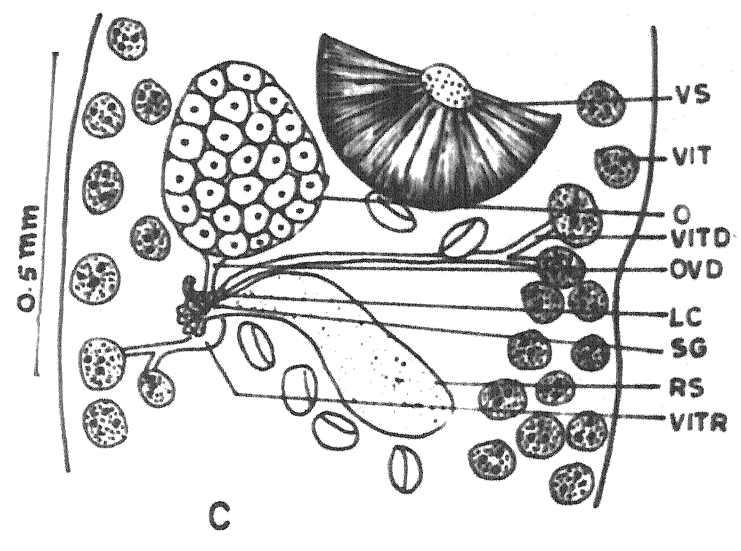
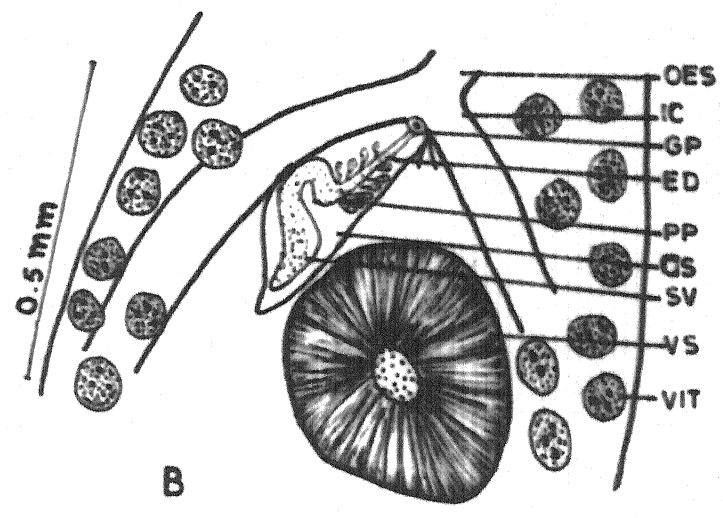
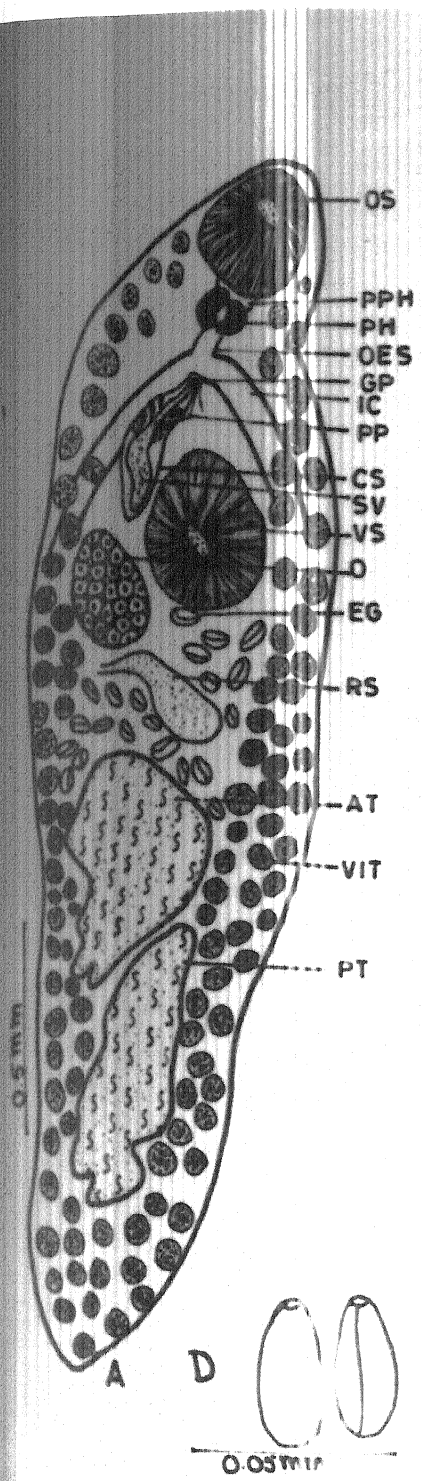
DISCUSSION

The collected specimens differ from E. cameronii Gupta, 1963 in the features like – the extension of intestinal caeca, vitelline follicles, position of cirrus sac, shape of ovary and also in the position of genital pore. These features are considered as individual variations. It has been redescribed.

Figure-10

Eucreadium cameronii Gupta, 1963

- A Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Family: Azygiidae

MEASUREMENTS

(All measurements were taken in mm)

Body length, 4.011 – 7.075; width, 1.50 – 2.63; oral sucker, 0.47 – 0.58 X 0.47 – 0.60; ventral sucker, 0.65 – 0.93 X 0.60 – 0.92; pre-pharynx, 0.01 – 0.04 X 0.02 – 0.04; pharynx, 0.13 – 0.18 X 0.10 – 0.17; oesophagus, 0.08 – 0.13 X 0.04 – 0.06; anterior testis, 0.27 – 0.40 X 0.24 – 0.38; posterior testis, 0.34 – 0.48 X 0.34 – 0.39; cirrus sac, 0.23 – 0.54 X 0.09 – 0.23; vesicular seminalis, 0.09 – 0.22 X 0.13 – 0.13; pars prostatica, 0.10 – 0.14 X 0.13 – 0.15; ejaculatory duct, 0.12 – 0.13 X 0.05 – 0.08; ovary, 0.27 – 0.48 X 0.26 – 0.49; receptaculum seminis, 0.09 – 0.24 X 0.10 – 0.18; egg, 0.04 – 0.08 X 0.04 – 0.06.

DISCUSSION

Genus Bundelatrema was suggested by Agrawal (1980) with the type species B. betwai and was placed in the sub-family Azygiinae Luhe, 1909 of the family Azygiidae Odhner, 1911. the new genus was established by distinguishing it from the genus Azygia Looss (1899) in having excretory arms not united anteriorly and from the genus Otodistomum Stafford, 1904 in having no genital cone or papilla in genital atrium.

The present form chiefly differs from the other known species in having a short pre-pharynx, ratio of testes, in the extension of vitelline follicles and uterus also occupying the anterior part of the body.

This species shows close resemblance with Bundelatrema orchhaensis (Agrawal, 1982) is having short oesophagus and spherical testes and elongated cirrus sac, which is present above ventral sucker. Anterior testes smaller than posterior testes.

This species is regarded as new species and named as Bundelatrema agarwali.

Key to the species of genus Bundelatrema Agrawal, 1980.

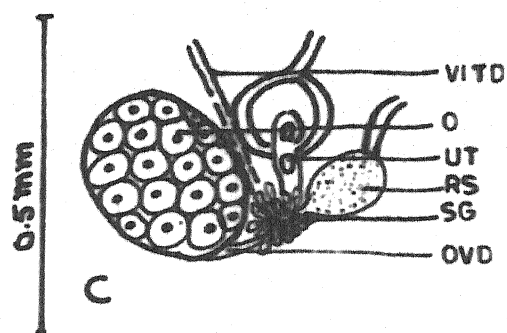
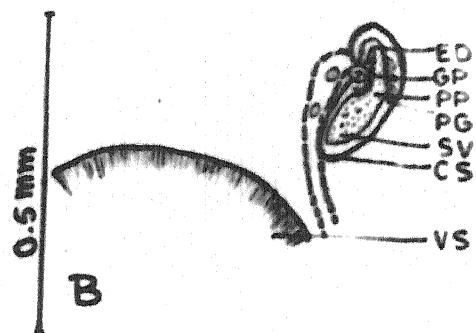
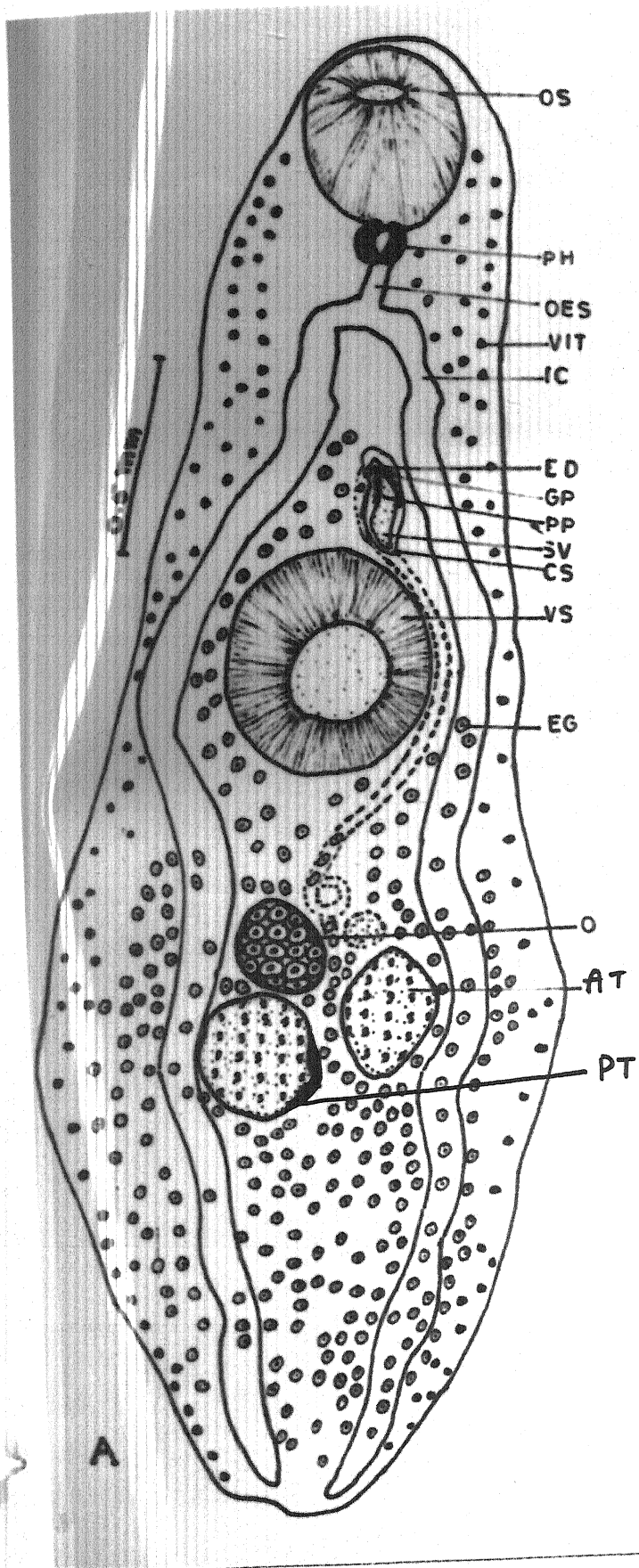
1. vitelline follicles present from anterior
and of body up to the level of ovary,
uterus confined to posterior half region
of body testes more or less equal : B. betwai
Agrawal, 1980
2. vitelline follicles present from anterior
of body up to posterior and of body
uterus also extends in to the anterior
portion of body anterior testis smaller
than posterior testis : B. orchhaensis
Agarwal, 1982

Figure 11

Bundelatrema agarwali n. sp.

- A. Dorsal view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and type enlarged (drawn from live specimen)
- D. Eggs enlarged





Family: Cephalogonimidae

Oudhia kanungoi Agarwal, 1980

(Fig. 12A, B, C, D)

Host	: <u>Rita rita</u> (Ham.)
Locality	:(a) Fish market, Jhansi :(b) Betwa River, Hamirpur, U.P.
No. of fishes examined	: (a) 80 : (b) 60
No. of fishes infected	: 4
Location	: Intestine
No. of specimens collected	: 3 + 1+2+1=7

DESCRIPTION

Body elongated, spinose, spines present up to the limit of posterior testis, with rounded anterior and posterior ends. Oral sucker terminal, funnel shaped. Ventral sucker pre-equatorial, circular, more or less equal to oral sucker. Pre-pharynx moderate. Pharynx oval, muscular. Oesophagus long, tubular. Intestinal caeca extending up to middle of posterior testis. Testes rounded, tandem in middle region of body, equal. Cirrus sac extending from middle of ventral sucker up to the middle of oral sucker, long, curved, encloses a bipartite vesicula seminalis, an oval pars prostatica surrounded with prostate gland cells and a long, narrow ejaculatory duct. Ovary oval, sub-median, just pre-equatorial, located in the left side of anterior testis. Receptaculum seminis small, oval, post-ovarian. Uterus occupies entire posterior body, continues as metraterm to open at genital pore. Shell glands surround the type. Laurer's canal present. Egg oval, operculated. Genital pore located in the right side of oral sucker. Vitelline follicles restricted from the level of ventral sucker up to the anterior level of posterior testis, 5 on each side, two vitelline ducts unite to open at type. Excretory bladder Y-shaped, excretory pore situated on dorsal side at posterior end of body.

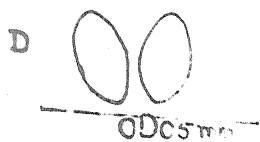
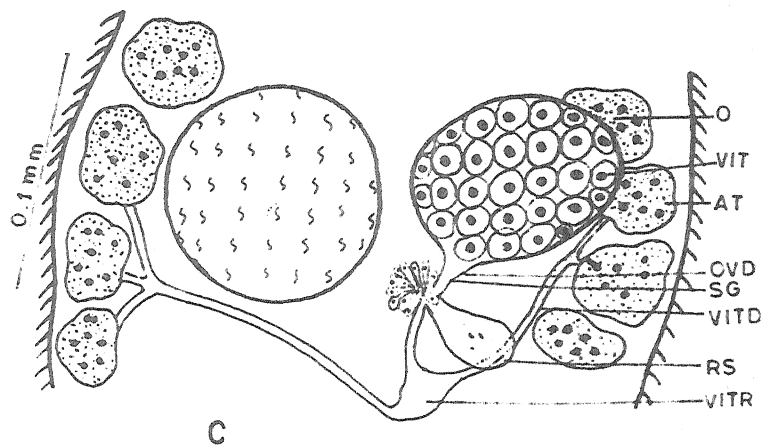
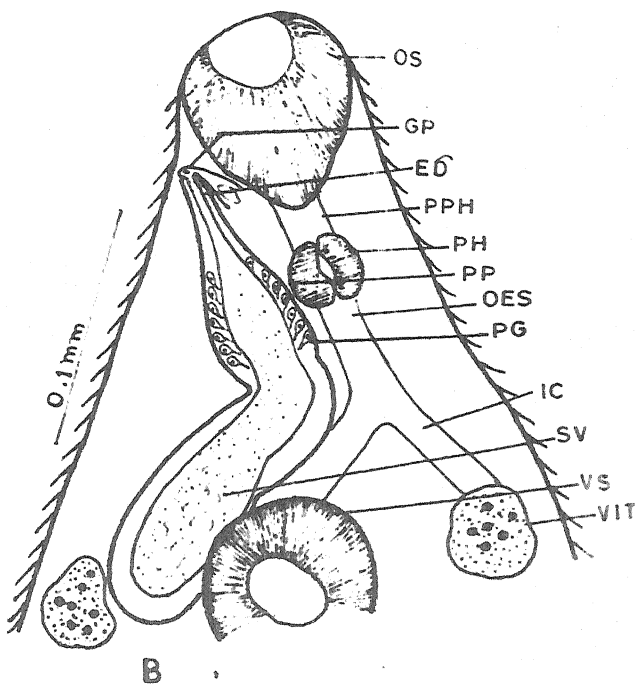
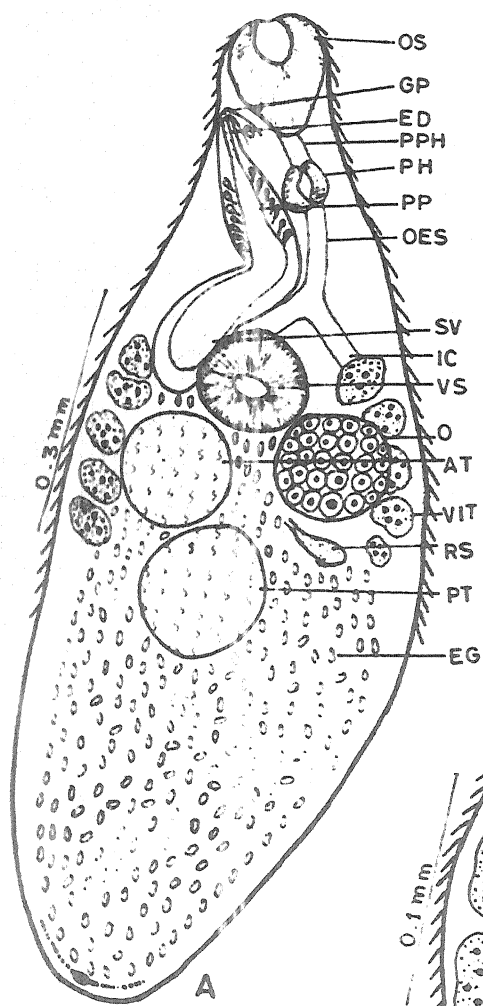
Key to the species of the genus Oudhia Gupta, 1955

1. Oesophagus short : 2
Oesophagus long : 3
2. Testes lie obliquely,
Genital pore at pre-pharynx zone : O. horai Gupta, 1955
3. Testes tandem, genital pore
At pore at pharyngeal zone : O. hardayali
Kumar and Agarwal, 1980
- Testes tandem, genital pore
At the middle level of oral sucker : O. kanungoi
Agrawal 1982

Figure-12

Oudhia kanungoi Agarwal, 1980

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



Family: Allocreadiidae

Orientocreadium batrachoides Tubangui, 1931.

(Fig. 13A, B, C, D)

Host	: <u>Clarias batrachus</u> (Linn.)
Locality	: River Yamuna, Hamirpur, U.P.
No. of fishes examined	: 80
No. of fishes infected	: 3
Location	: Intestine
No. of specimens collected	: 3 + 2 + 1 = 6

DESCRIPTION

Body elongated, smooth or spinose, with rounded anterior and blunt posterior ends. Oral sucker sub-terminal, spherical. Ventral sucker pre-equatorial, rounded, more or less equal to oral sucker. Pre-pharynx prominent. Pharynx oval, muscular. Oesophagus very short. Intestinal caeca reaching up to hind end of the body. Testes oval or rounded, post-equatorial, more or less equal in size. Cirrus sac lies on right side of ventral sucker, extending from anterior margin of ovary up to front of ventral sucker, elongated, encloses a saccular vesicula seminalis interna followed by a pars prostatica surrounded with numerous prostate gland cells and a long ejaculatory duct.

A vesicula seminalis externa extends up to anterior margin of ovary. Ovary oval, equatorial. Uterus extends in whole hind body, opens at genital pore by metraterm. Shell glands few in number, surround the type. Laurer's canal present. Egg oval, yellow, operculated. Genital pore sub-median, pre-acetabular. Vitelline follicles extend from the anterior margin of ovary up to hind end of body, two vitelline ducts unite to form a yolk reservoir to opens at type by a common vitelline duct. Excretory bladder tubular, excretory pore lies at posterior end.

MEASUREMENTS

(All measurements were taken in mm)

Body length, 1.95 – 2.42; width, 0.45 – 0.49; oral sucker, 0.19 – 0.23 X 0.18 – 0.22; ventral sucker, 0.19 – 0.23 X 0.18 – 0.23; pre-pharynx, 0.04 – 0.06 X 0.07 – 0.08; pharynx, 0.09 – 0.12 X 0.07 – 0.10; oesophagus, 0.07 – 0.08 X 0.06 – 0.07; anterior testis, 0.19 – 0.20 X 0.17 – 0.18; posterior testis, 0.18 – 0.19 X 0.19 – 0.22; cirrus sac, 0.40 – 0.42 X 0.06 – 0.08; vesicula seminalis interna, 0.08 – 0.15 X 0.05 – 0.07; vesicula seminalis externa, 0.10 – 0.13 X 0.33 – 0.35; ovary, 0.12 – 0.16 X 0.11 – 0.14; egg, 0.027 – 0.033 X 0.013 – 0.018.

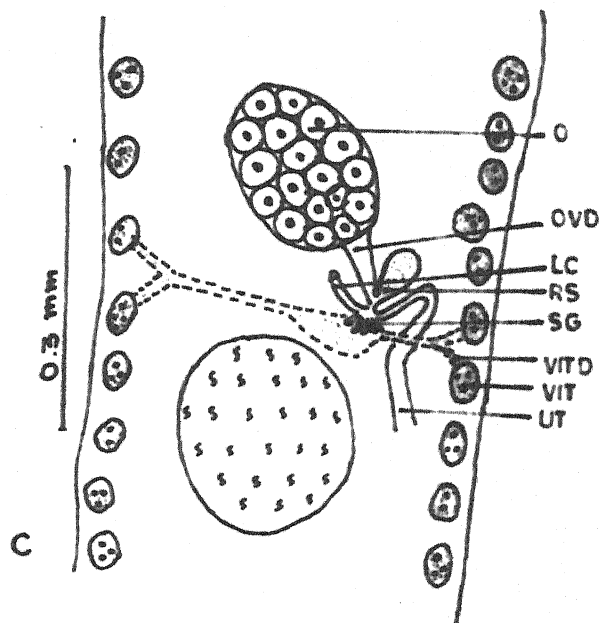
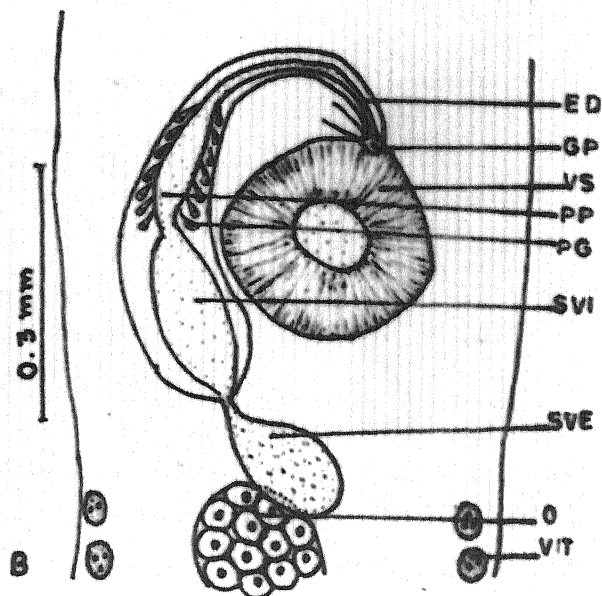
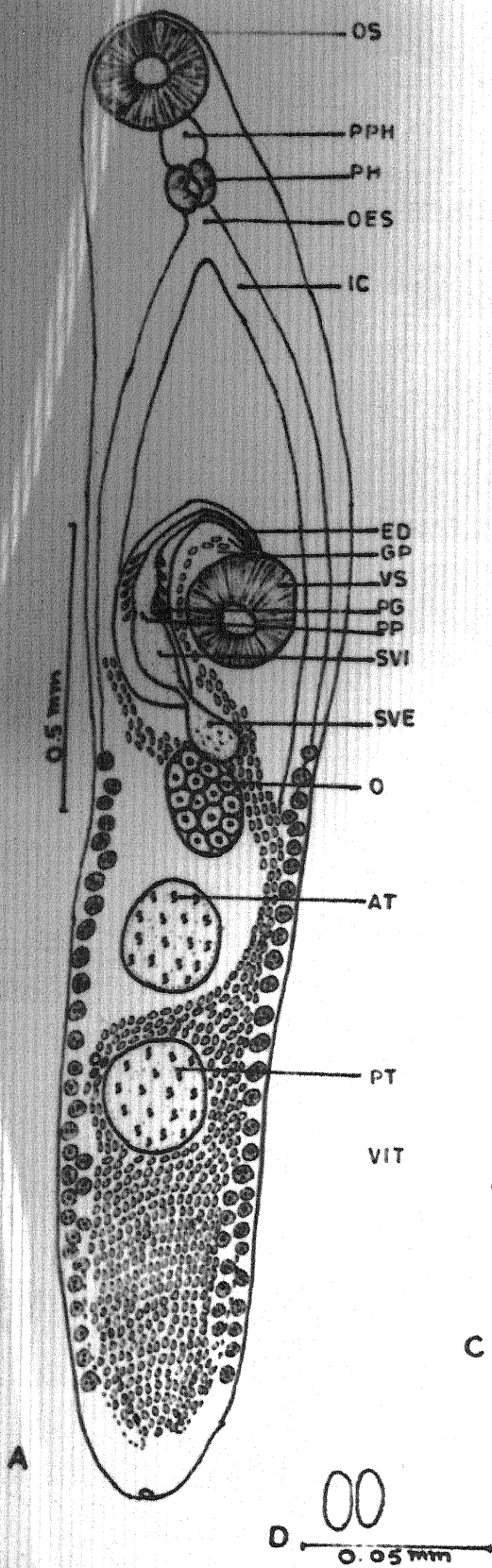
DISCUSSION

The present form belongs to Orientocreadium batrachoides Tubangui, 1931. Earlier workers viz. Beverly-Burton (1962), Fischthal and Kuntz (1963), Agrawal (1963) and Pandey (1971) is species from different fishes. This is first record of Orientocreadium batrachoides from Hamirpur; Uttar Pradesh. Agarwal 1982 also has been redescribed Orientocreadium batrachoides in intestine Clarias batrachus. Also Chandra and Banerjee (1993) reported Allocreadium bengalensis in the intestine of Mastacabelus armatus. This species has been redescribed.

Figure -13

Orientocreadium batrachoides Tubangui, 1931

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and type enlarged (drawn from live specimen)
- D. Eggs enlarged



Family: Paramphistomidae

Helostomatis belatalensis Agarwal, 1980

(Fig. 14A, B, C, D)

Host	: <u>Oxygaster bacalia</u> (Ham.)
Locality	: Belatal, Mahoba, UP
No. of fishes examined	: 100
No. of fishes Infected	: 4
Location	: Intestine
No. of specimens collected	: 2+1+3+1=7

DESCRIPTION

Body elongated, aspinose, anterior end. Oral sucker terminal, and oval, posteriorly having claviform oral diverticula. Acetabulum prominent, large, more or less rounded, without hood, located at the posterior end of body. Oesophagus moderate, posteriorly having oesophageal bulb. Intestinal caeca reaching up to little anterior to the level of acetabulum. Testes rounded, entire, equal, pre-equatorial, diagonal, intercaecal. Cirrus pouch oval, located on left side of oesophagus, enclosing a bipartite vesicula seminalis, pars prostatica surrounded with prostate gland cells and an ejaculatory duct. Ovary rounded, post-equatorial, sub-median. Uterine coils extensive, filling the entire body; uterus opens at the genital pore by a short metraterm. Shell glands surround the type. Eggs large, oval, operculated. Genital pore inbetween the two oral diverticula and provided with a genital sucker. Vitelline follicles extending from the region of oral sucker up to the middle level of acetabulum. Excretory bladder oval. Excretory pore terminal; lymphatic ducts three pairs.

MEASUREMENTS

(All measurements were taken in)

Body length, 2.05-2.60; width, 0.89-0.92; oral sucker, 0.20-0.24 X 0.20-0.23; oral diverticula, 0.15-0.31 X 0.04-0.06; oesophagus, 0.27-0.38 X 0.05-0.06; oesophageal bulb, 0.08-0.12 X 0.06-0.10; acetabulum, 0.41-0.65 X 0.49-0.64; right testis, 0.19-0.27 X 0.21-0.23; left testis, 0.17-0.24 X 0.19-0.21; cirrus sac, 0.24-0.28 X 0.10-0.15; vesicula seminalis, 0.09-0.13 X 0.08-0.10; pars prostatica, 0.12-0.13 X 0.04-0.06; genital sucker, 0.08-0.12 X 0.09-0.11; ovary, 0.13-0.19 X 0.13-0.21; egg, 0.07-0.12 X 0.06-0.08.

DISCUSSION

So far seven species have been described under the genus Helostomatis (Fukui, 1929) Travassos, 1934 viz. H. helostomatis maccallum, 1905; H. sakrei Bhalerao, 1937; H. cirrhini Gupta and Kumari, 1970; H. indica verma, 1973; H. mulleri Gupta and Ahmad, 1979; H. bundelkhandensis Agarwal and Agarwal 1980 and H. thapri. The present form mainly differs from the other known species in the extension of vitelline follicles. It further differs from H. helostomatis, H. sakrei, H. cirrhini, H. indica, H. mulleri and H. thapari in the shape of oral diverticula and from H. helostomatis, H. sakrei, H. indica in the shape of gonad and from H. bundelkhandensis in the position of genital pore and testes. Helostomadis belatalensis is the species identified by Agarwal (1982) in Oxygaster bacalia in Bundelkhand region. Agarwal and Sharma (1989) has also reported genus Pseudoorientodiscus which differs from other known in reference to size and position of ovary and testes, as well as extension of intestinal cecae. It has been redescribed.

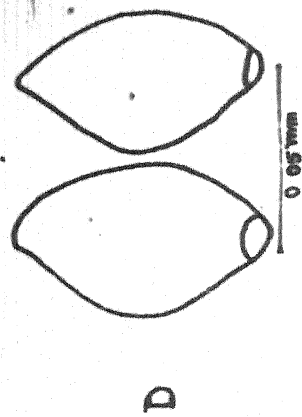
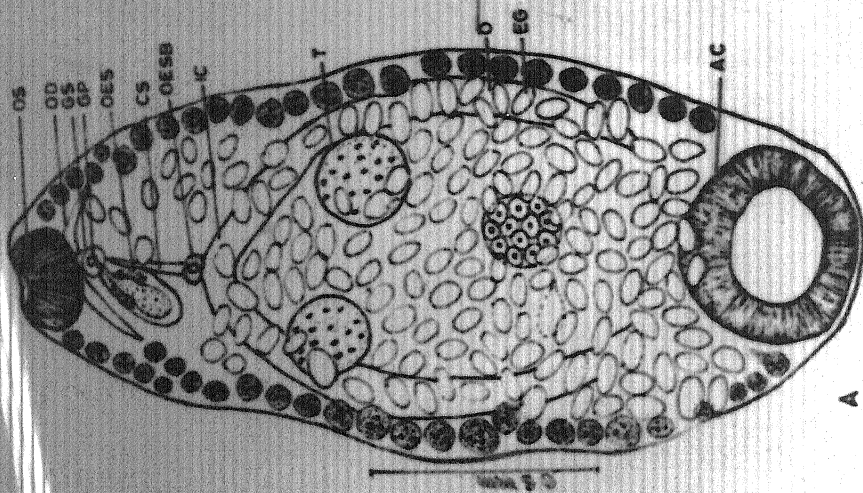
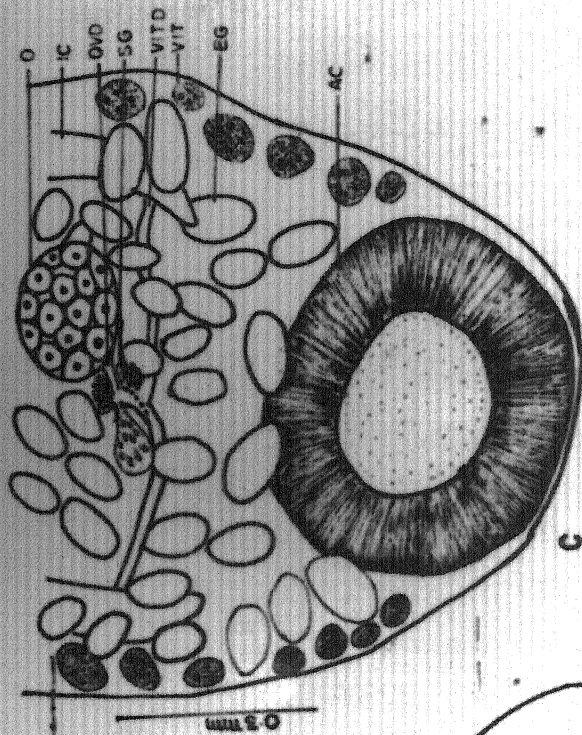
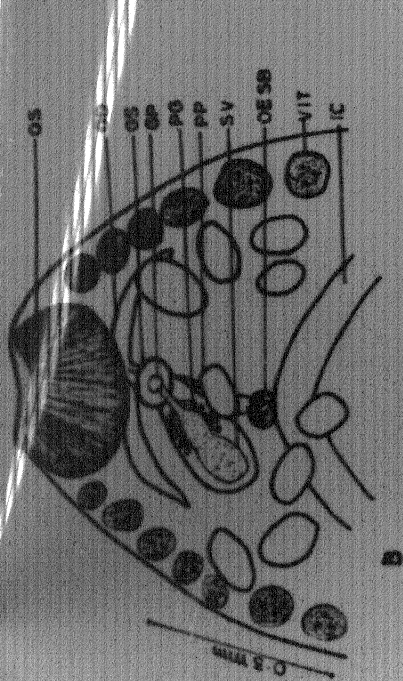
Key to the species of the genus Helostomatis (Fukui, 1929)
Travassos, 1934.

- Vitelline follicles extending from oral
sucker to the caecal ends : 2
- Vitelline follicles extending from oral
sucker to middle level of acetabulum : H. belatalensis n. sp.
- Vitelline follicles extending from the
middle level of oesophagus up to
mehlis gland complex : H. cirrihin Mehta
& Kumari 1970
- Vitelline follicles extending from or
little anterior to intestinal bifurcation
or from the oesophageal bulb to caecal
ends : 3
- oral diverticula short, without bulb,
genital pore at the level of right
diverticulum : H. thapari Agrawal,
1980
- oral diverticula long, without bulb,
genital pore inbetween the oral
sucker and oesophageal bulb : H. bundelkhandensis
& Agrawal, 1981
- testes irregular : 4
- Testes oval : 5

Figure-14

Helostomatis belatallensis Agarwal, 1980

- A. Ventral view
- B. Anterior part of body showing cirrus sac enlarged (drawn from live specimen)
- C. Posterior part of body showing ovary and type enlarged (drawn from the live specimen)
- D. Egg enlarged



Family: Opisthorchidae

Opisthorchis chandrai n. sp.

(Fig. 15 A, B, C, D)

Host	: <u>Channa marulius</u> (Ham.)
Locality	: River ken, Banda, U.P.
No. of fishes examined	: 120
No. of fishes infected	: 4
Location	: Gall bladder
No. of specimens collected	: 3+2+1+2=8

DESCRIPTION

Body elongated with blunt anterior and posterior ends; covered with small backward directed spines up to posterior end of ovary. numerous anteriorly, sparse posteriorly and absent in posterior region. Oral sucker sub-terminal, oval. Ventral sucker pre-equatorial, spherical, smaller than oral sucker. Pre-pharynx short, pharynx oval, muscular. Oesophagus short. Intestinal caeca reaching up to the end of body. Testes triangular, tandem, located in posterior region of body; anterior testis slightly larger than the posterior testis. Cirrus sac absent. Vasicula seminalis thin walled, extending from middle of body up to anterior end of ventral sucker. Ovary pre-testicular median spherical. Receptacular seminis sac-like, larger than ovary, located in between anterior testis and ovary. Uterus arises from right side of ootype, intercaecal, forming simple and loops. Metraterm short, open at genital pore. Laurer's cannal present. Egg oval yellow, non-operculated. Genital pore median, pre-acetabular. Vitelline follicles extend from little posterior to vesicular seminalis up to posterior testis, two vitelline ducts unite with each other before opening at ootype. Excretory bladder straight, extends straight extend anterior to ovary, excretory pore terminal.

Opisthorchis chandrai n. sp.

(Fig. 15 A, B, C, D)

Host	: <u>Channa marulius</u> (Ham.)
Locality	: River ken, Banda, U.P.
No. of fishes examined	: 120
No. of fishes infected	: 4
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DESCRIPTION

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MEASUREMENTS

(All measurement were taken in mm)

Body length, 1.71 - 2.25; width, 0.29 - 0.39; oral sucker, 0.09 - 0.01 x 0.09 - 0.11; ventral sucker, 0.10 - 0.13 x 0.11 - 0.12; pre-pharynx, 0.13 - 0.18 x 0.03 - 0.05; pharynx 0.06 - 0.08 x 0.05 - 0.07; oesophagus, 0.13 - 0.16 x 0.04 - 0.05; anterior testis, 0.22 - 0.28 x 0.15 - 0.17 posterior testis, 0.19 - 0.21 x 0.15 - 0.17; vesicular seminalis, 0.85 - 1.00 x 0.05 - 0.09; ovary, 0.12 - 0.15 x 0.10 - 0.14; receptaculum seminis, 0.12 - 0.14 x 0.08 - 0.11; egg, 0.015 - 0.025 x 0.008 - 0.012.

DISCUSSION

The present form belongs to genus Opisthorchis. The gomtia was established by Thapar (1930) with G. piscicola as type species from Bagarias bagarias. Mehra (1914) considered it as synonym of the genus Opisthorchis Blanchard, 1895 and named it as O. gomtia (Thapar, 1930). Subsequently, Dayal (1949) and Gupta (1955) retained the genus Gomtia as vailed one on the bases of shape and position of excretory stem but latter on workes like - Bisseru (1941), Rai and Pande (1965) and Rai (1971) have supported the view of Mehra (1941) Dayal (1949) also added two species viz. G. gagatia and G. luckhowia from the fishes of Luckhnow. Rai (1971) pointed out that the main stem of excretory ballader is dorsal to the testis slightly sigmod and not truly bladder is dorsal to the testes. Slightly sigmoid and not truly S-shaped he also regarded O. mehrai Agarwal, 1959 and O. thapari agarwal, 1959 as synonyms of O. pedicellate. Kumar, 1979 also added one species O. dayali from Rita rita. The author agrees with Rai (1971) and considered the genus Gomtia as synonyms of the genus Opisthorchis. Henceforth all the three species of Gomtia are now considerd viz. G. piscicola as O. gomtia.

Thus the species of Opisthorchis which are reported from siluroid fishes of India are O. pedicellata Verma, 1927 from gall bladder of Bagarias bagaria and Rita rita; O. pedicellatea minuta

Mehra 1941 from the gall bladder of Mystus seeghala and Wallago attu; O.gomtia (Thapar 1930) Mehra 1941 from the intestine of a Bagarias bagarias; O gagatia (Dayal, 1949) Rai, 1971 from the intestine of Gangatia cenia; O.lucknowia (Dayal, 1949) Rai from 1971, from the intestine of Mystus vitatus and O. dayali Kumar, 1979 from the intestine of Rita rita. Gupta and Kumari (1970) have mentioned O. pedicellated intermedia from gall baladder of Rita rita and Matacembulus armatus as sub-species of O.pedicellata. The present form comes closer to O. pedicellata minuta in having small pre-pharynx, short oesophagus and further resemble with O.pedicellata, O.gorkhpurensis O.dayali, in the extension of vitelline follicles and cuticular spines. Various species of Opisthorchidae were reported to be present in stomach, intestine and body cavity of Channa marulius, C. striata and Macrognathus aculeatus (Khanum et al 1993, Khanum and Parveen 1997, Chandra and Banerjee 1992), Members of family Opisthorchidae typically use fish as intermediate host, they have been also reported in certain piscivorous mammals as well as birds. Bashirulla (1973) and Ahmed and Ezaz (1997) reported infection of Opisthorchis sp. Metacercaria in Rita rita. They located this parasite in body cavity.

The new species Opisthorethis chandrai is close to O. agarwali in having similar characters. This new species is named as Opisthorchis chandrai in the honour of Prof. Ramesh Chandra, Hon'ble Vice-chancellor, Bundelkhand University, Jhansi, UP.

Key of species of the genus Opisthorchis Blanchard, 1895.

1. Intestinal caeca reaching up to hind end of body :2
 Intestinal caeca reaching up to hind end of anterior testis
 or slightly beyond it :3
2. Testes lobed : O. pedicellata Verma, 1927
 Testes entire : 4
2. oral sucker smaller than
 ventral sucker : 5
 Oral sucker equal to
 Ventral sucker : O. lucknowia (Dayal, 1949)
 Rai, 1979
3. Vetelline follicles extend
 From posterior end of vesicular
 Seminalis to middle of
 ventral sucker : O. dayali Kumar, 1979

Vetelline follicles extend
 From posterior end of
 Ventral sucker up to posterior
 Margin of ovary : O. pedicellata minute
 Mehra, 1941

Vetelline follicles extend
 from posterior end of ventral
 sucker to middle of testes zone : O. gorkhpurensis Rai
 1971

Vetelline follicles extend
 From little posterior of vesicula
 Seminalis to the posterior
 Testes : O. agarwali 1982

4. Pre-pharynx equal to
Oesophagus, receptaculum
Seminis smaller than ovary

: O. gomtia
(Thapar, 1930)
Mehra, 1941

Pre-pharynx largen than
Oesophagus, receptaculum
Seminis larger than ovary

: O. gagatia
(Dayal, 1949) Rai, 1971

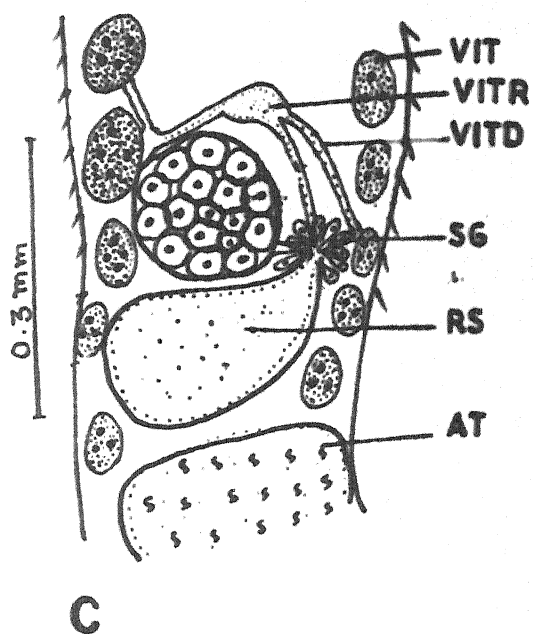
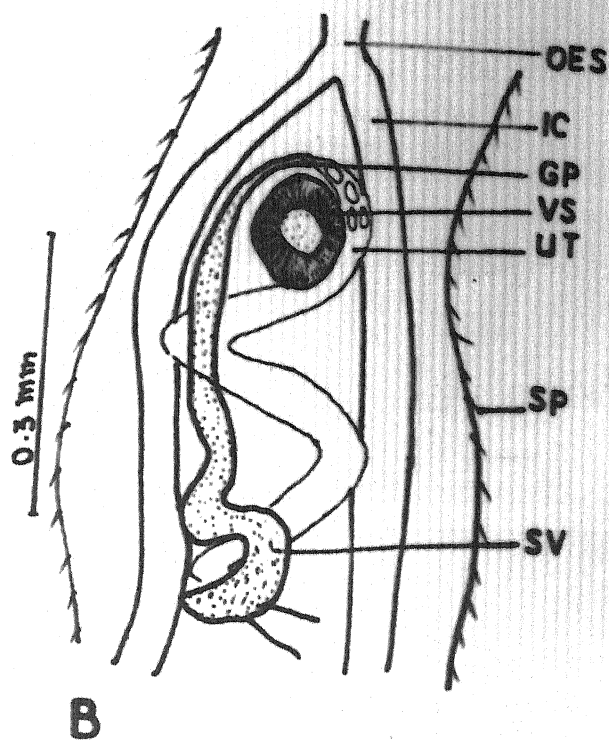
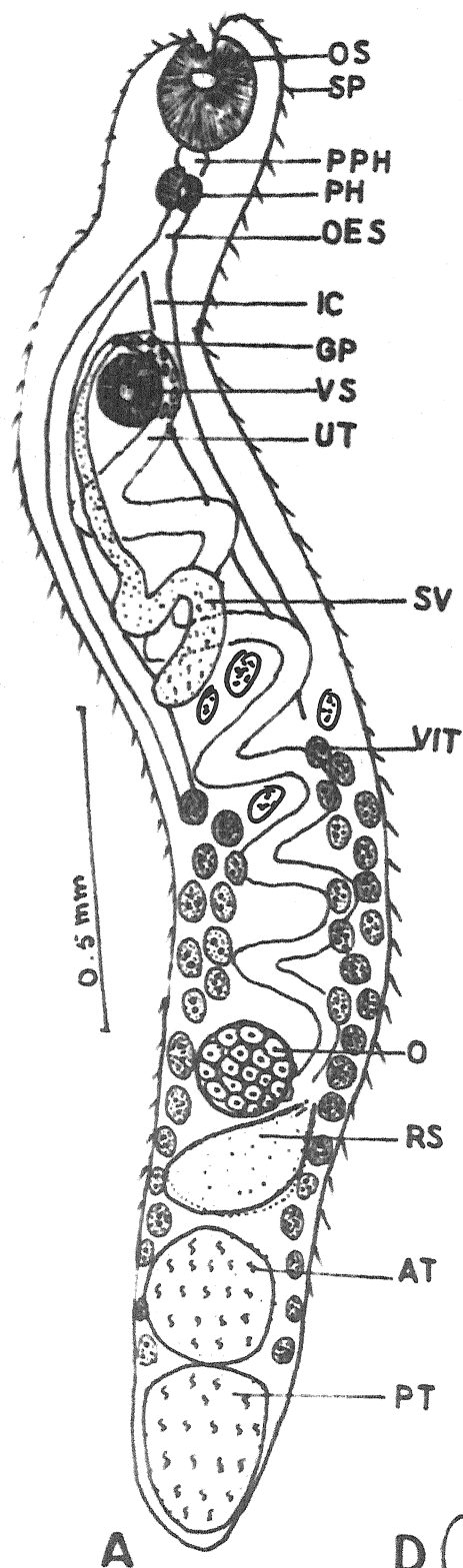
5. Pre-pharynx short
Oval and Muscular

: O. agarwali
Agarwal 1982

Figure-15

Opisthorchis chandrai n.sp.

- A. Ventral view
- B. Cirrus sac enlarged (drawn from live specimen)
- C. Ovary and ootype enlarged (drawn from live specimen)
- D. Eggs enlarged



KEY TO LETTERING IN FIGURES

AC	Acetabulum
AS	Anterior sucker
AT	Anterior testis
C	Cirrus
CA	Common atrium
CS	Cirrus sac
CVD	Common vitelline duct
EB	Excretory bladder
ED	Ejaculatory duct
EG	Egg
EP	Excretory pore
GA	Genital atrium
GG	Genital gland
GP	Genital pore
IC	Intestinal caecum
INT	Intestine
LC	Laurer's canal
O	Ovary
OD	Oral diverticulum
OVD	Oviduct
OES	Oesophagus
OESB	Oesophageal bulb
OS	Oral sucker
PG	Prostae gland cells
PH	Pharynx
PP	Pars prostatica

PPH	Pre-pharynx
PT	Posterior testis
RS	Receptaculum seminis
S	Penduncle
SG	Shell gland
SP	Spines
SV	Vesicula seminalis
SVE	Vesicula seminalis externa
SVI	Vesicula seminalis interna
T	Testis
TEN	Tentacles
UT	Uterus
VIT	Vitelline duct
VIDT	Vitelline reservoir
VS	Ventral sucker

SUMMARY

The perusal of literature clearly shows that no attention has been paid by the helminthologist to work out the trematode fauna of fresh water fishes of Bundelkhand region. In the present study the digenetic trematodes of fresh water fishes of bordering districts of Uttar Pradesh are worked out. The water bodies of five districts of Uttar Pradesh viz. Banda, Hamirpur, Jalaun, Jhansi and Lalitpur were selected for the survey. The fishes of rivers like- Betwa, Dhasan, Ken, Pahuj, Urmil, and Yamuna; reservoirs like- Maudaha dam, Matatila dam, Rajghat dam and lakes like- Barawasagar, Belatal, Benisagar, Jagatsagar, Kiratsagar, Kulpahar tank, Rathtal were examined for helminth infection from March, 2002, to December, 2004. A total of 10 species of fishes has been examined. Though, collections of trematodes, cestodes, nematodes and acanthocephalans have been made but only the digenetic trematodes are presented in the thesis entitled "Digenetic trematodes of fishes of Bundelkhand Region, India", and efforts have been made to detail out their morphology and taxonomy. The trematodes have been studied both in living condition and in fixed, stained mounts.

The thesis includes the description of 14 species of digenetic trematodes of fishes are redescribed. 14 Camera Lucida sketches have supported the observations. The description of each species has been followed by a discussion to establish the claim of its being new species with a key of the species under the genus. Further, a general introduction, a brief historical review of Indian literature pertaining to the digenetic trematodes of the fresh water fishes of India, materials and methods, a host-parasite list, physiography of Bundelkhand region, climate conditions, have also been given in the beginning of the dissertation. A list of references, consulted during the course of present investigation and those having direct bearing on the text, has been given at the end of the thesis. The thesis covers

pages including a map of Bordering districts of Uttar Pradesh showing various localities surveyed for helminth fauna of fresh water piscine hosts.

The writer is responsible for all the observations, diagrams in the thesis.

Faustula jhansiansis n. sp.: Location: Intestine; Host: Cirrhinus mrigala (Ham.); Locality: Fish market Mauranipur. The present from comes closer to F. clupii but differs from it in the extension of vitelline follicles and in having seven lobed ovaries.

Faustula brevichrus (Srivastava, 1935) Yamaguti, 1958; Location: Intestine; Host: Cirrhinus mrigala (Ham.); Locality: Fish market Mauranipur. It is redescribed and having slight variations in the ratio of suckers, in the extension of cirrus sac and vitelline follicles. Bucephalus thapari Agarwal 1980; Location: Intestine; Host: Bagarius bagarius (Ham.) Locality: Fish market Attara Banda U.P. The present from comes closer to O. pedicellata minuta in having small pre-pharynx, short oesophagus and further resembles with O. pedicellata, O. gorkhpurensis, O. davalii in the extension of intestinal caeca but differs from all other known species in the extension of vitelline follicles and cuticular spines.

Tremiorchis ranarum Mehra and Negi, 1926: Location: Intestine; Host: Rita rita (Ham.); Locality: fish market Jalaun U.P. It is redescribed. The present from slightly differs from earlier description in variation measurements, in the length of oesophagus and in extension of vitelline follicles. Rita rita (Ham.) is recorded as an additional piscine host.

Gorgotrema hamirpurensis Agarwal 1980: Location: Intestine; Host: Puntius sarana (Ham.) Locality: River Betwa, Hamirpur, and U.P. It chiefly differs from the only known species G. barbuis Dayal, 1938 in having comparatively short oesophagus, in the shape of ovary and in the position of genital pore.

Phyllodistomum vittatusi Gupta, 1953: Location: Intestine; Host: Puntius sarana (Ham.) Locality: Fish market Rath, Hamirpur, U.P. It is redescribed and slightly differs in the size of oesophagus and testes being larger than ovary.

Dactylostomum narayansis n. sp. Location: Stomach: Host: Mastacembelus armatus (Lac.); Locality: Kirat Sagar Tall Mahoba, U.P. It is distinguished from the other known species in having two dactyls on the ventral sucker and in position of genital pore except D. jhansiesis.

Gangatrema betwai Agarwal, 1980. Location: Intestine; Host: Rita rita (Ham.); Locality: River Betwa, Orai, U. P. It differs from the other two known species in the extension of vitelline follicles and in the ratio of suckers.

Eureadium cameronii Gupta, 1963: Location: Intestine; Host: Catla catla (Hem.); Locality: Fish market Jhansi, U.P. It differs from the known species in the position of ovary and in the number and size of eggs.

Bundelatrema agarwali n. sp. Location: Liver; Host: Puntius sarana (Ham.); Locality: River Betwa, Jhansi. It is distinguished from the other known species in having a short pre-pharynx, ratio of testes, in the extension of vitelline follicles and uterus.

Oudhia kanungoi Agarwal, 1980. Location: Intestine; Host: Rita rita (Ham.) Locality: (a) Fish market Jhansi, (b) River Betwa, Hamirpur, U.P., Fish market Jhansi, U.P. It differs from the other known species in the ratio of suckers, in extension of vitelline follicles, in the position of gonads and genital pore and also in the extension of cuticular spines.

Orintocreadium batachoides Tubangui, 1931: Location: Intestine; Host: Clarias batrachus (Linn.); Locality: River Yamuna, Hamirpur, U.P. It is redescribed. However, it slightly differs from the earlier account.

Helostomatis belatalensis Agarwal, 1980 Location Intestine; Host: Oxygaster bacaila (Ham.); Belatal, Mahoba, U.P. It has been distinguished from the other known species in the extension of vitelline follicles in the shape of oral diverticulum and in the position of genital pore and testes. This species has been rediscibed.

Opisthorchis chandrai n.sp. Location: Gall bladder; Host: Bagarius bagarius (Ham.); Locality: Fish market Banda, U.P. The present from comes closer to O. pedicellata minuta in having small pre-pharynx, short oesophagus and further resembles with O. pedicellata, O. gorkhpurensis, O. davali in the extension of intestinal caeca but differs from all other known species in the extension of vitelline follicles and cuticular spines

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